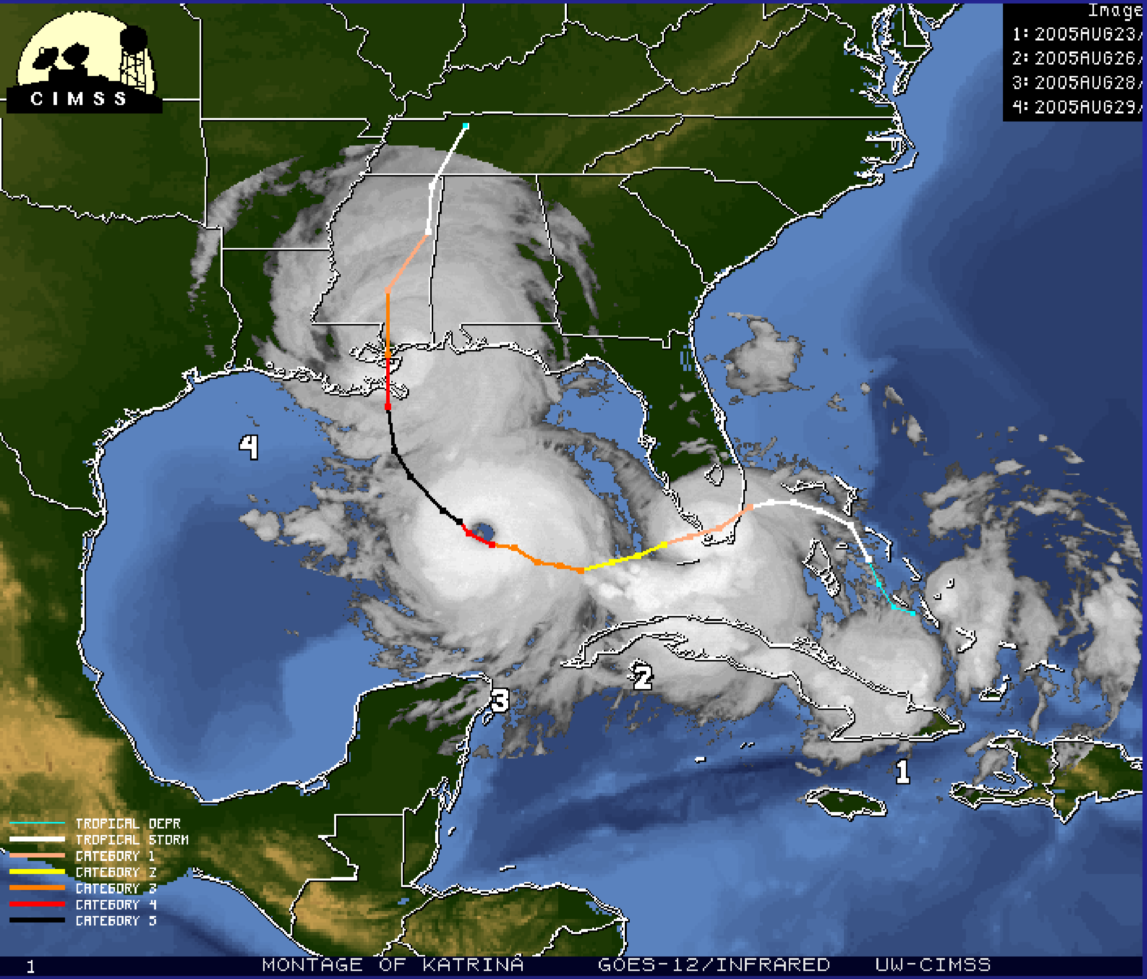
Hurricanes Katrina and Rita:

The Unwatering of New Orleans

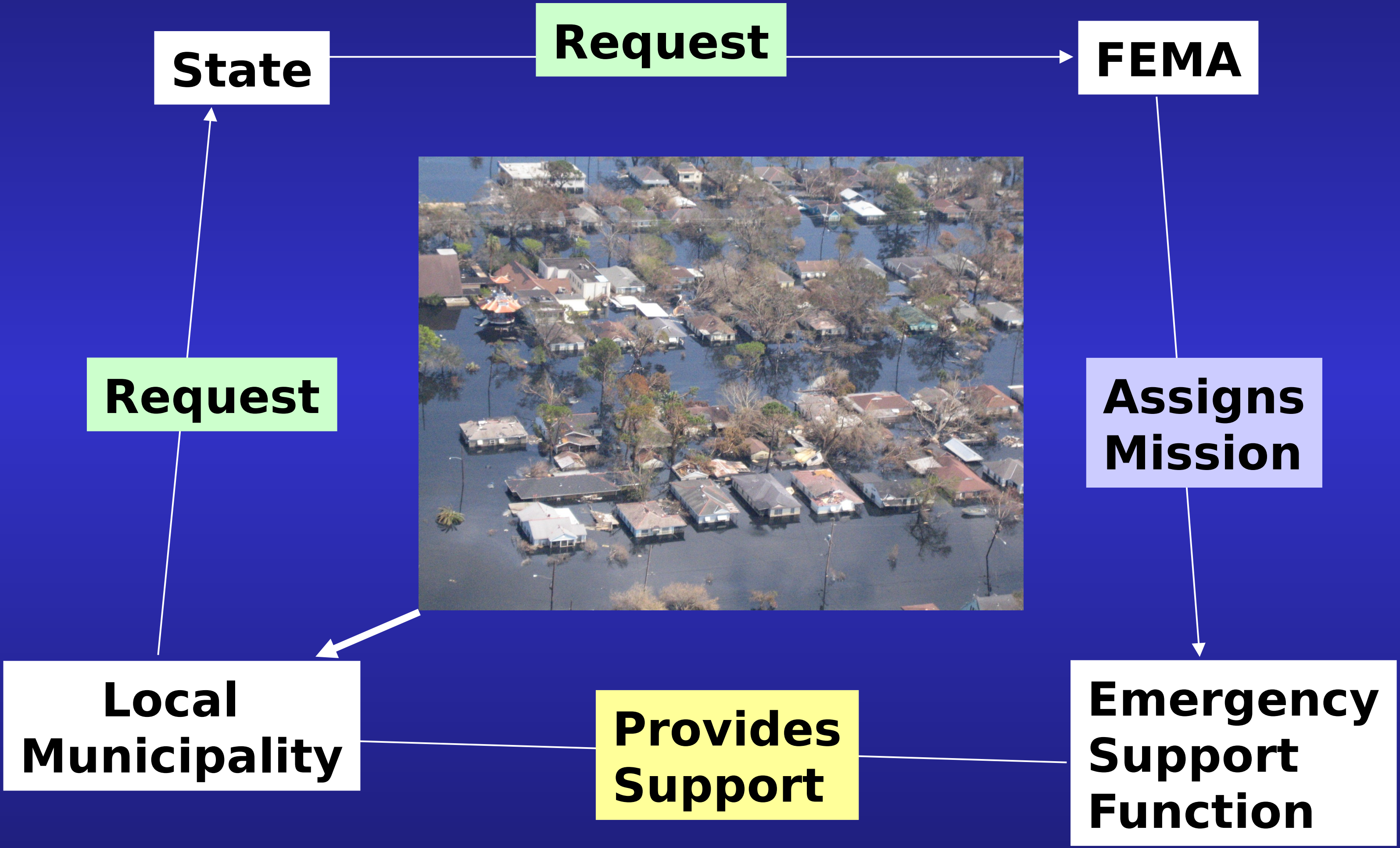
Colonel Duane Gapinski, P.E.

Hurricane Katrina


CIMSS
Image
1: 2005AUG23/
2: 2005AUG26/
3: 2005AUG28/
4: 2005AUG29/
4
3
2
1
TROPICAL DEPR
TROPICAL STORM
CATEGORY 1
CATEGORY 2
CATEGORY 3
CATEGORY 4
CATEGORY 5
1
MONTAGE OF KATRINA
GOES-12/INFRARED
UW-CIMSS

- One of America’s largest natural disasters
- More than 1,300 dead
- 127 MPH wind at landfall
- Maximum surge of 28 to 30 feet along Mississippi coast
- 51.9 million CY of debris (Louisiana and Mississippi)
- 80 percent of New Orleans flooded
- $96B in damages

National Response Plan



State

Request

FEMA

Assigns Mission

Emergency Support Function

Provides Support

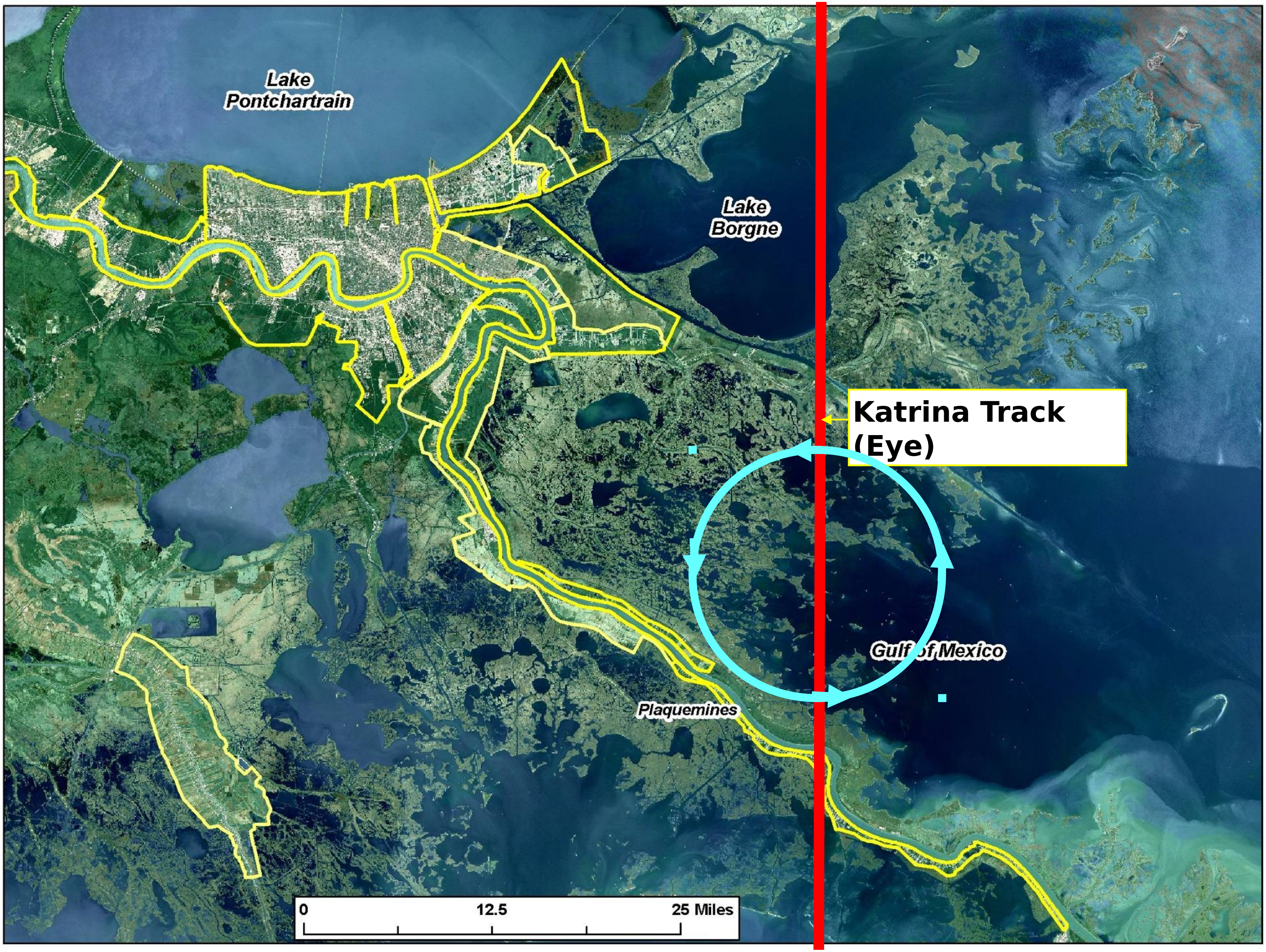
Local Municipality

Request

US Army Corps
of Engineers ®

Task Force Unwatering

Mission: Unwater the areas affected by Hurricane Katrina (and later, Rita) and provide an interim level of protection so traditional recovery operations can begin

Lake Pontchartrain
Lake Borgne
Katrina Track (Eye)
Gulf of Mexico
Plaquemines
0
12.5
25 Miles

US Army Corps
of Engineers ®

Storm Surge

One Team: Relevant, Ready, Responsive, Reliable

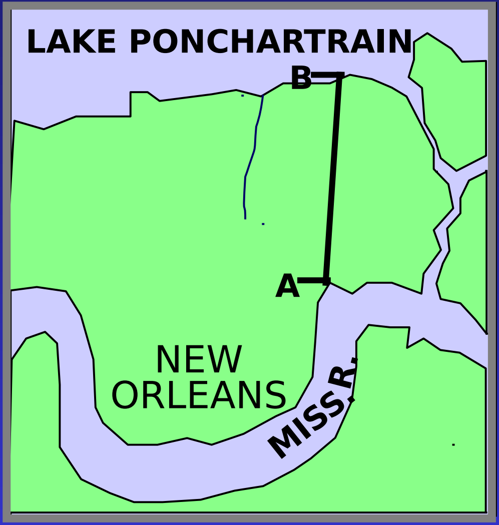
Ground Elevation Model

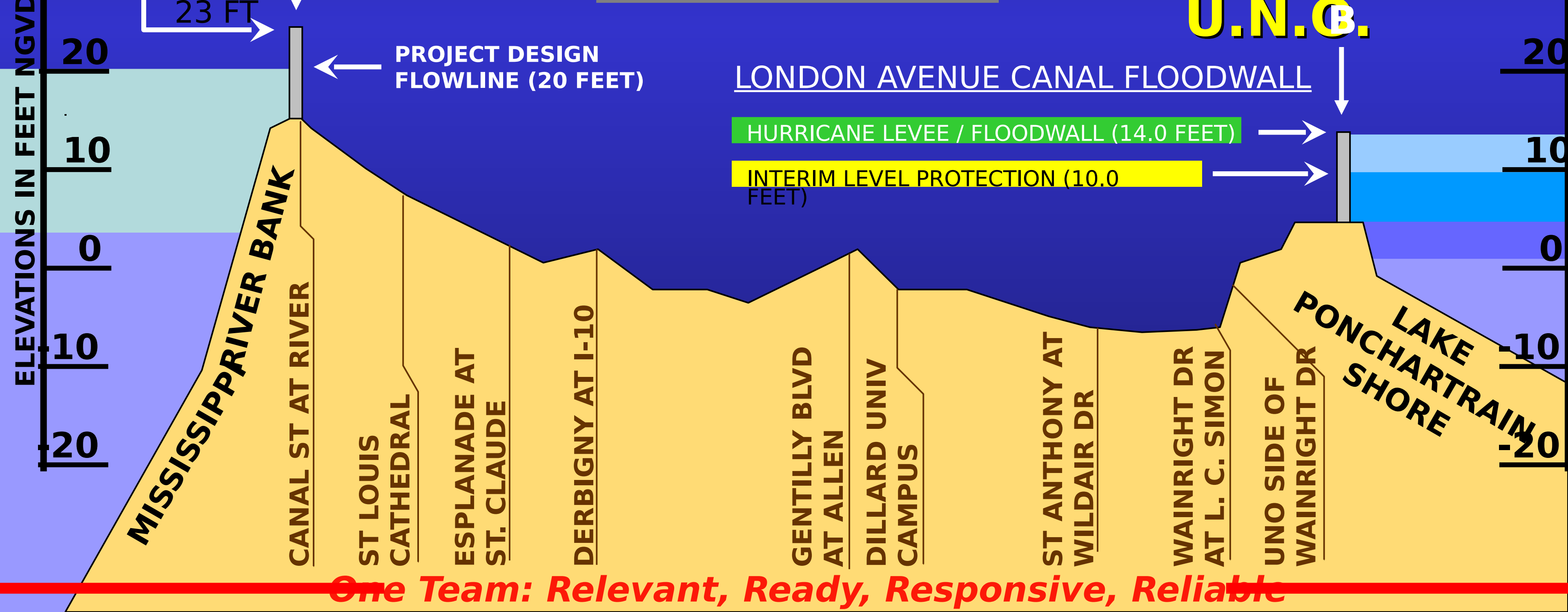
US Army Corps of Engineers ®

US Army Corps of Engineers ®

City of New Orleans Ground Elevations

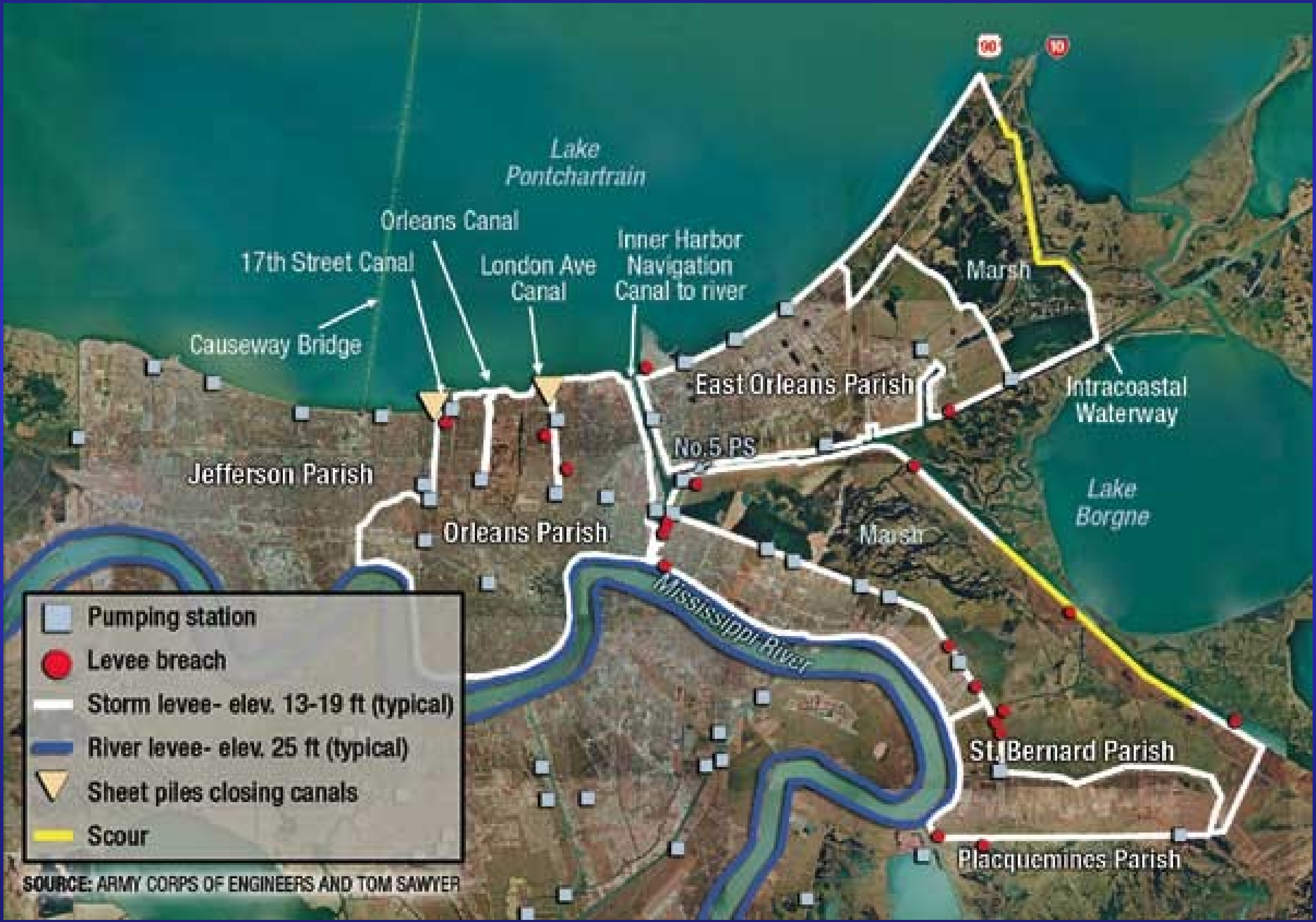
From Canal St. at Mississippi River to the Lakefront at U.N.O.


LAKE PONCHARTRAIN
B
A
NEW ORLEANS
MISS. R.


FLOODWALL ALONG MISSISSIPPI RIVER
A
23 FT
PROJECT DESIGN FLOWLINE (20 FEET)
B
LONDON AVENUE CANAL FLOODWALL
HURRICANE LEVEE / FLOODWALL (14.0 FEET)
INTERIM LEVEL PROTECTION (10.0 FEET)
ELEVATIONS IN FEET NGVD
30
20
10
0
-10
-20
MISSISSIPPI RIVER BANK
CANAL ST AT RIVER
ST LOUIS CATHEDRAL
ESPLANADE AT ST. CLAUDE
DERBIGNY AT I-10
GENTILLY BLVD AT ALLEN
DILLARD UNIV CAMPUS
ST ANTHONY AT WILDAIR DR
WAINRIGHT DR AT L. C. SIMON
UNO SIDE OF WAINRIGHT DR
LAKE PONCHARTRAIN SHORE

US Army Corps
of Engineers ®

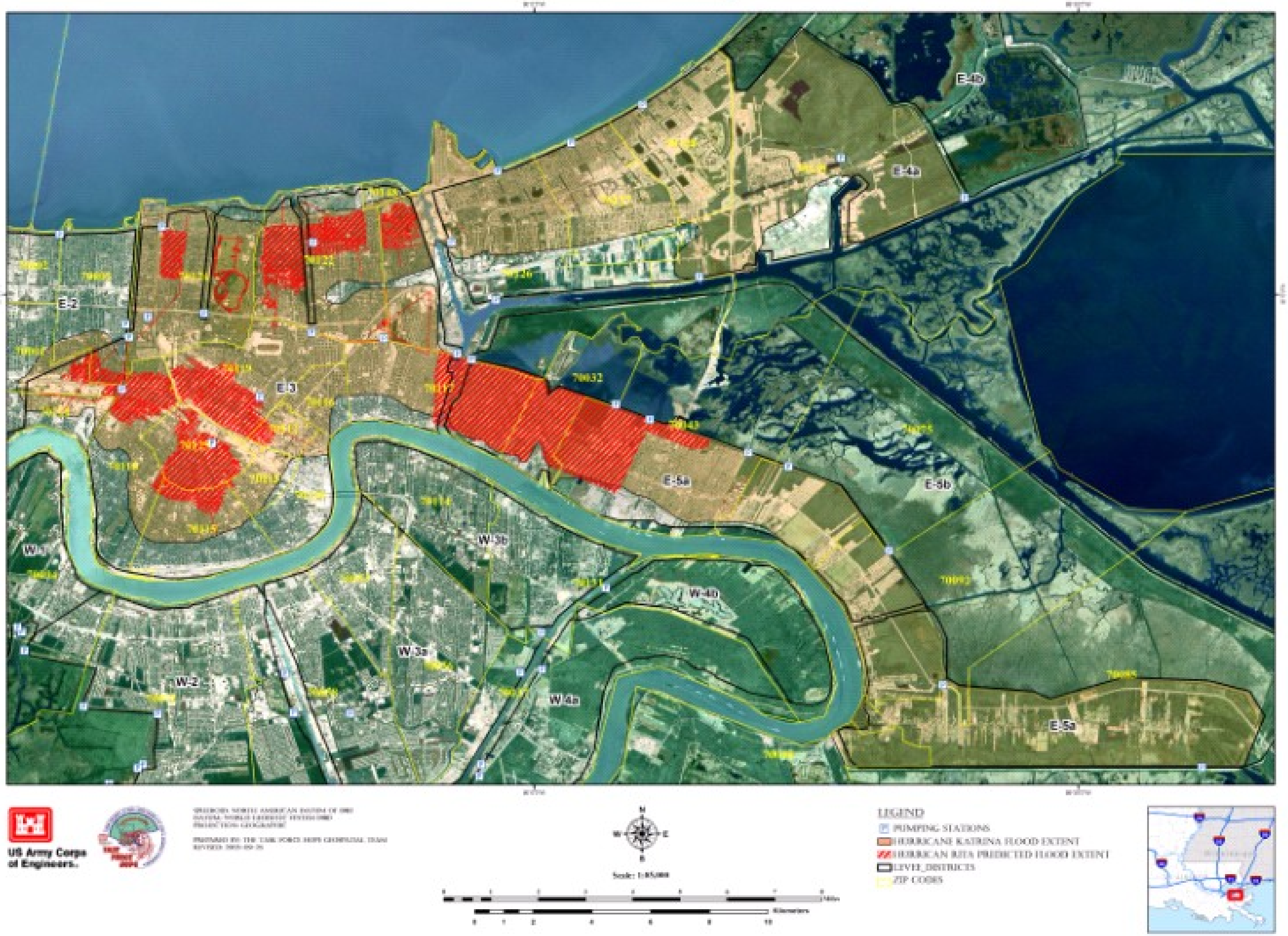
Metropolitan New Orleans


90
10
Lake Pontchartrain
Orleans Canal
17th Street Canal
London Ave Canal
Inner Harbor Navigation Canal to river
Causeway Bridge
Marsh
East Orleans Parish
Intracoastal Waterway
No.5 PS
Jefferson Parish
Orleans Parish
Lake Borgne
Marsh
Mississippi River
St. Bernard Parish
Placquemines Parish
Pumping station
Levee breach
Storm levee- elev. 13-19 ft (typical)
River levee- elev. 25 ft (typical)
Sheet piles closing canals
Scour

SOURCE: ARMY CORPS OF ENGINEERS AND TOM SAWYER

Drainage System

New Orleans Flooding

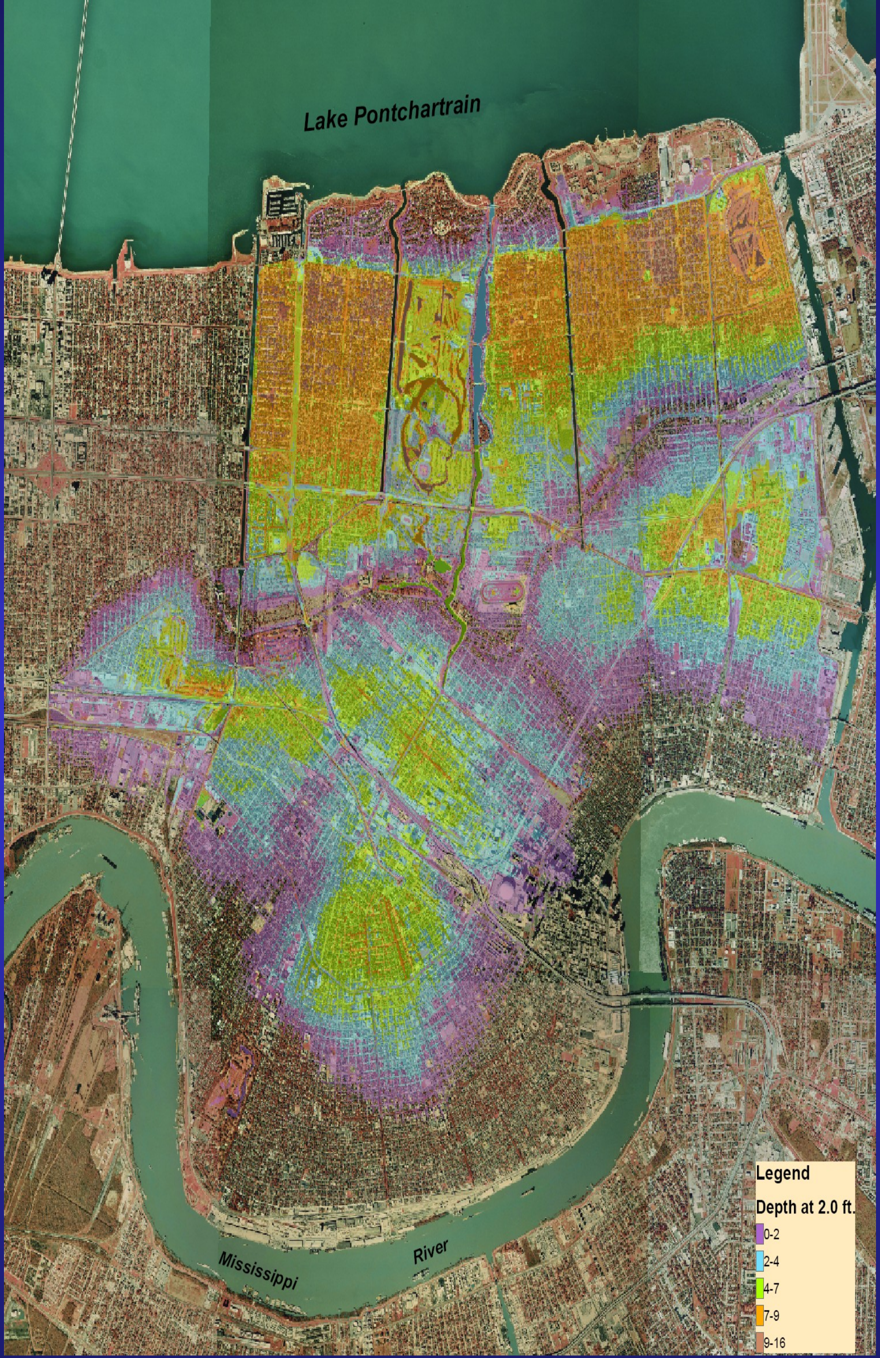

E-4b
E-4a
E-2
E-3
70032
70043
E-5a
E-5b
70092
W-1
W-3b
W-4b
W-3a
W-2
W-4a
E-5a
N
S
E
W
Scale: 1:85,000
Miles
Kilometers
LEGEND
PUMPING STATIONS
HURRICANE KATRINA FLOOD EXTENT
HURRICAN RITA PREDICTED FLOOD EXTENT
LEVEE_DISTRICTS
ZIP CODES

US Army Corps of Engineers.

SPHEROID: NORTH AMERICAN DATUM OF 1983
DATUM: WORLD GEODETIC SYSTEM 1984
PROJECTION: GEOGRAPHIC

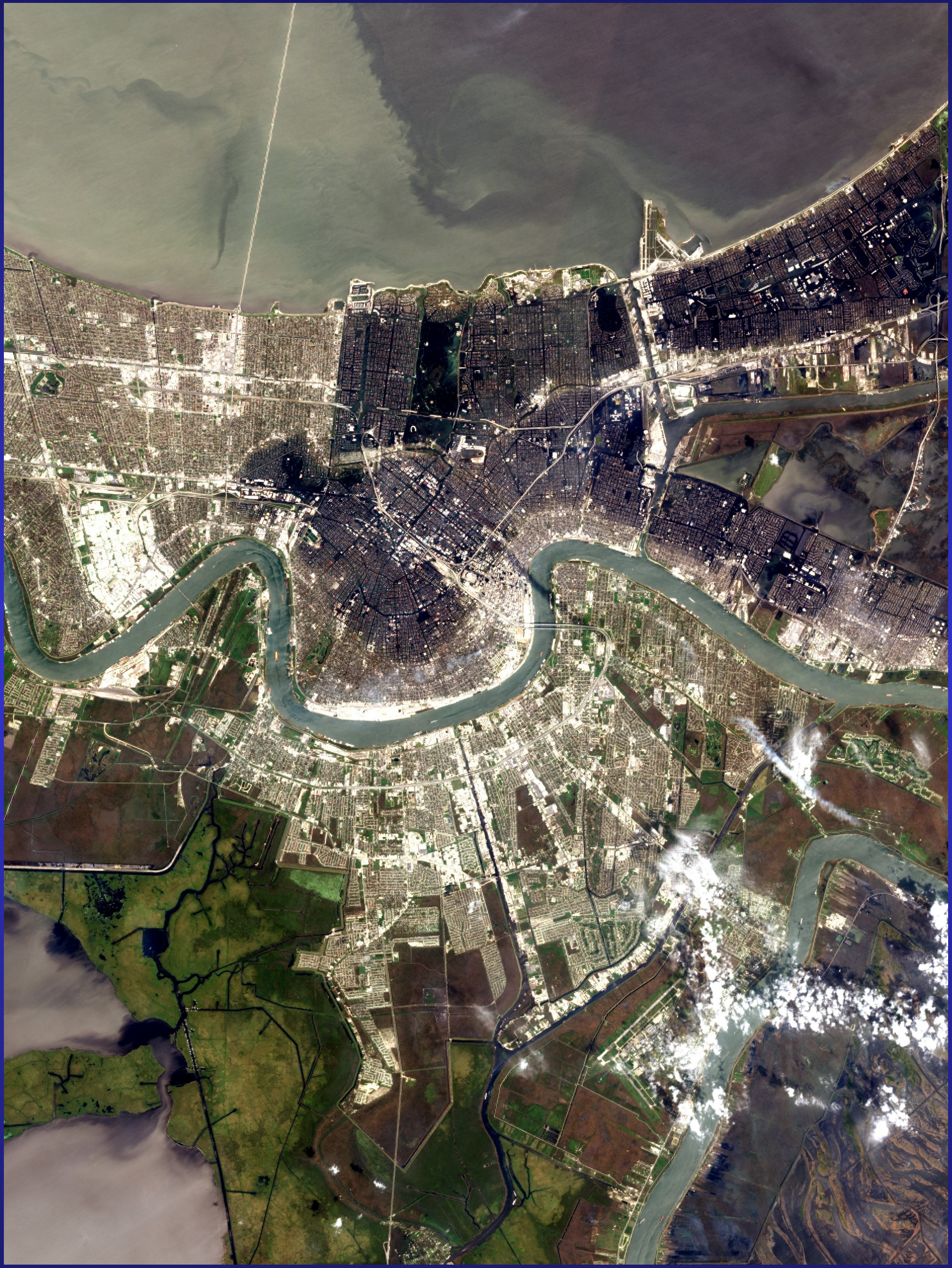
PREPARED BY THE TASK FORCE HOPE GEOSPATIAL TEAM
REVISED: 2005-09-[illegible]

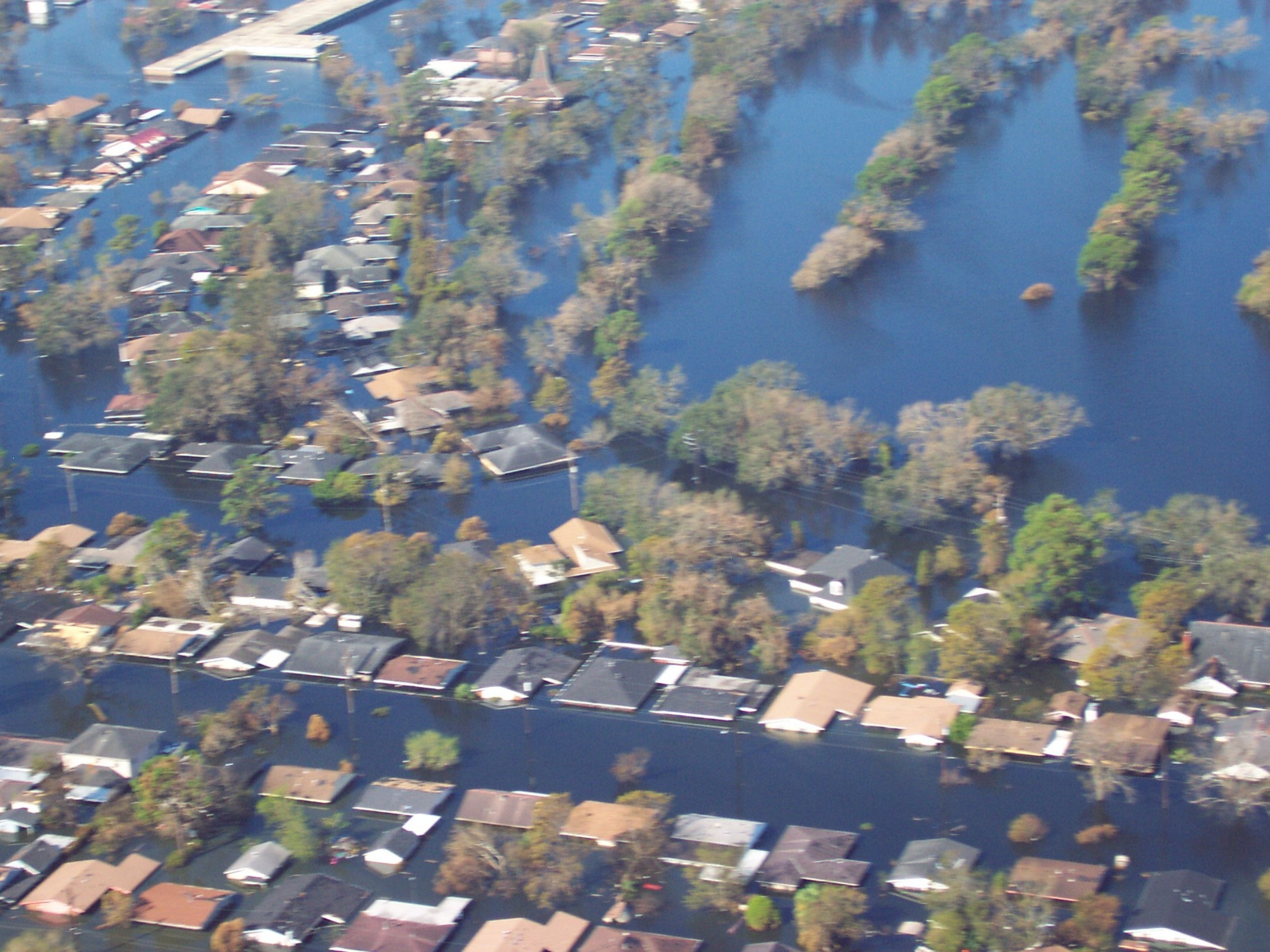
US Army Corps
of Engineers ®

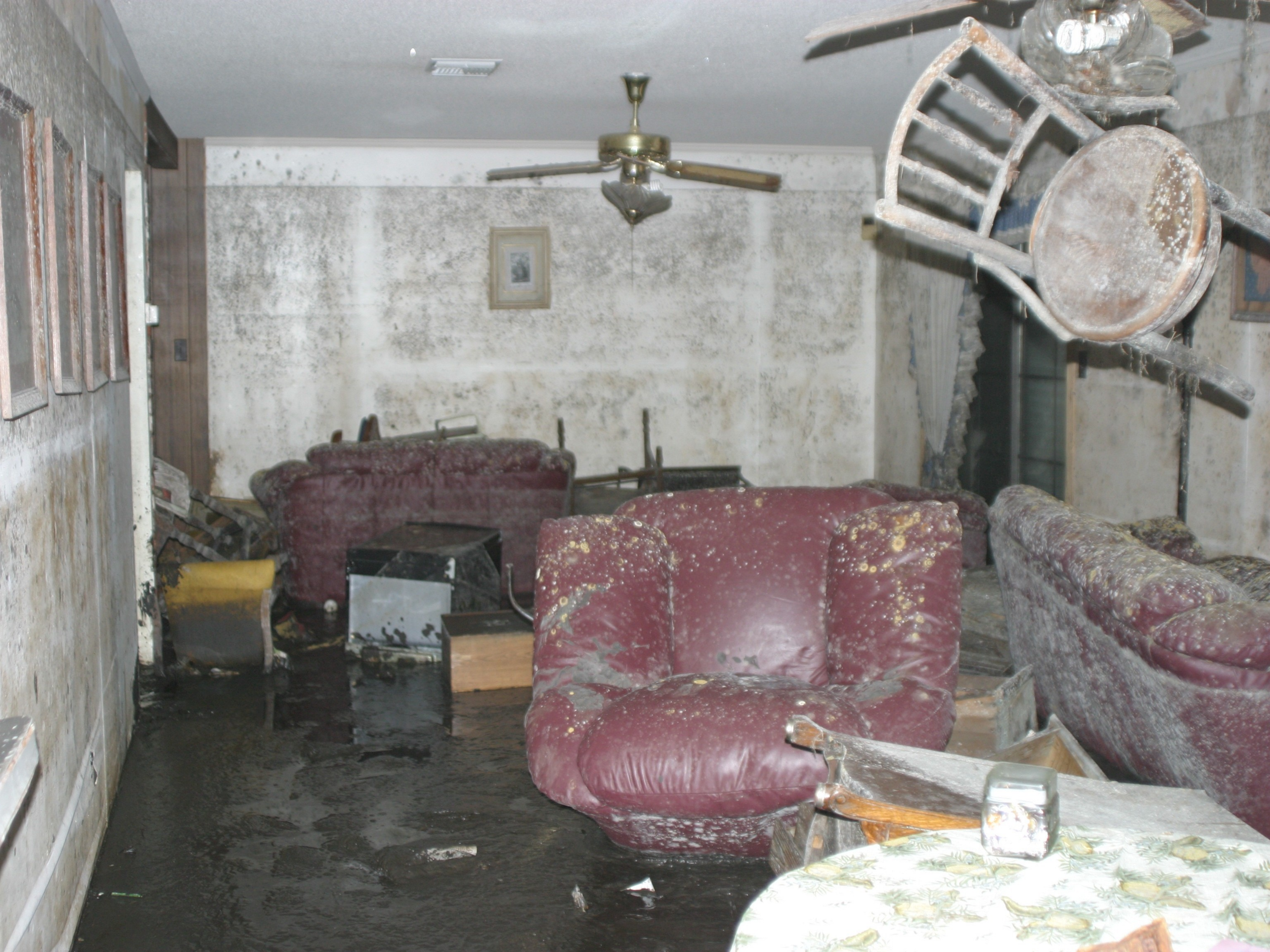

Lake Pontchartrain
Mississippi
River
Legend
Depth at 2.0 ft.
0-2
2-4
4-7
7-9
9-16

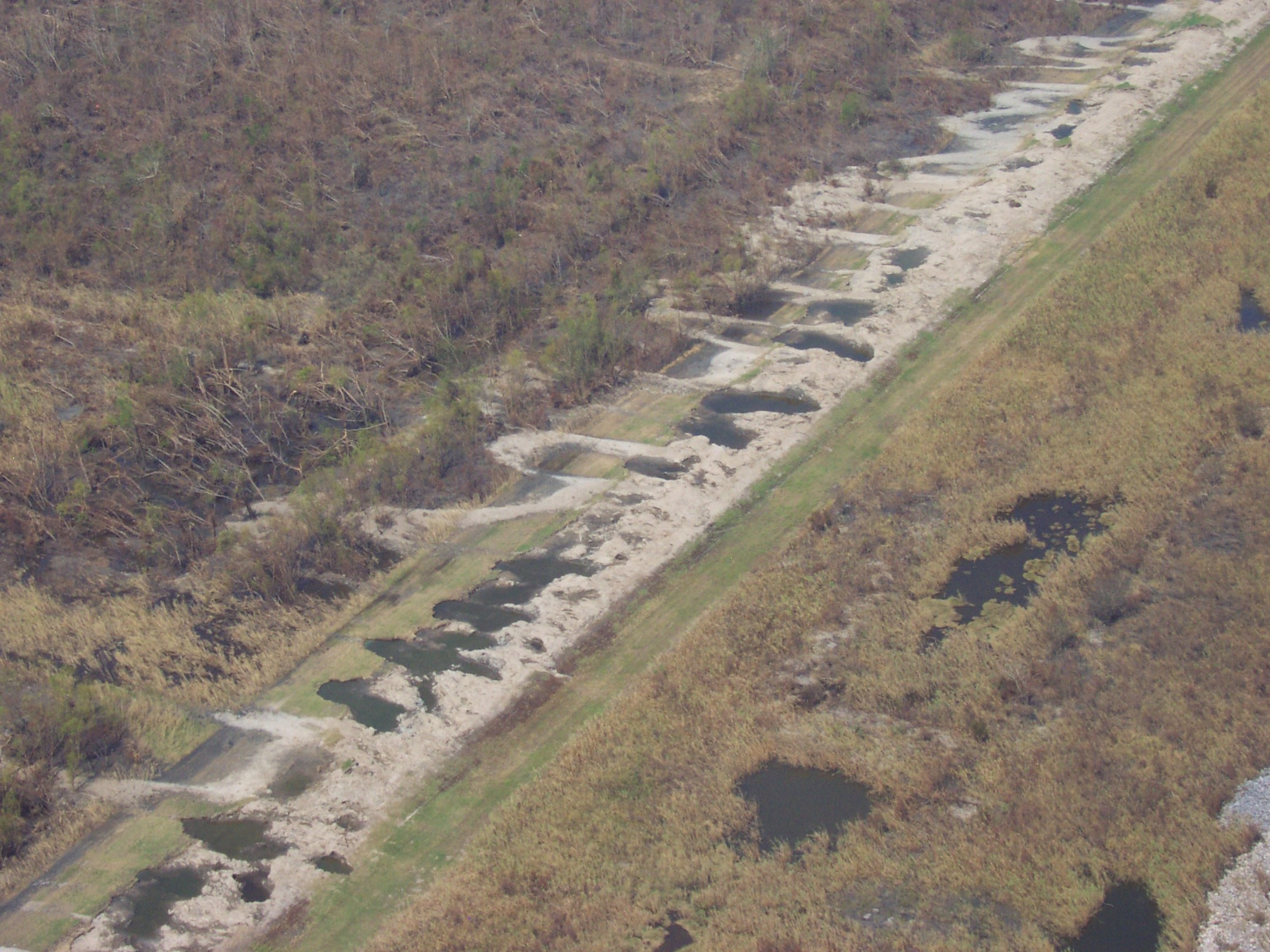
One Team: Relevant, Ready, Responsive, Reliable

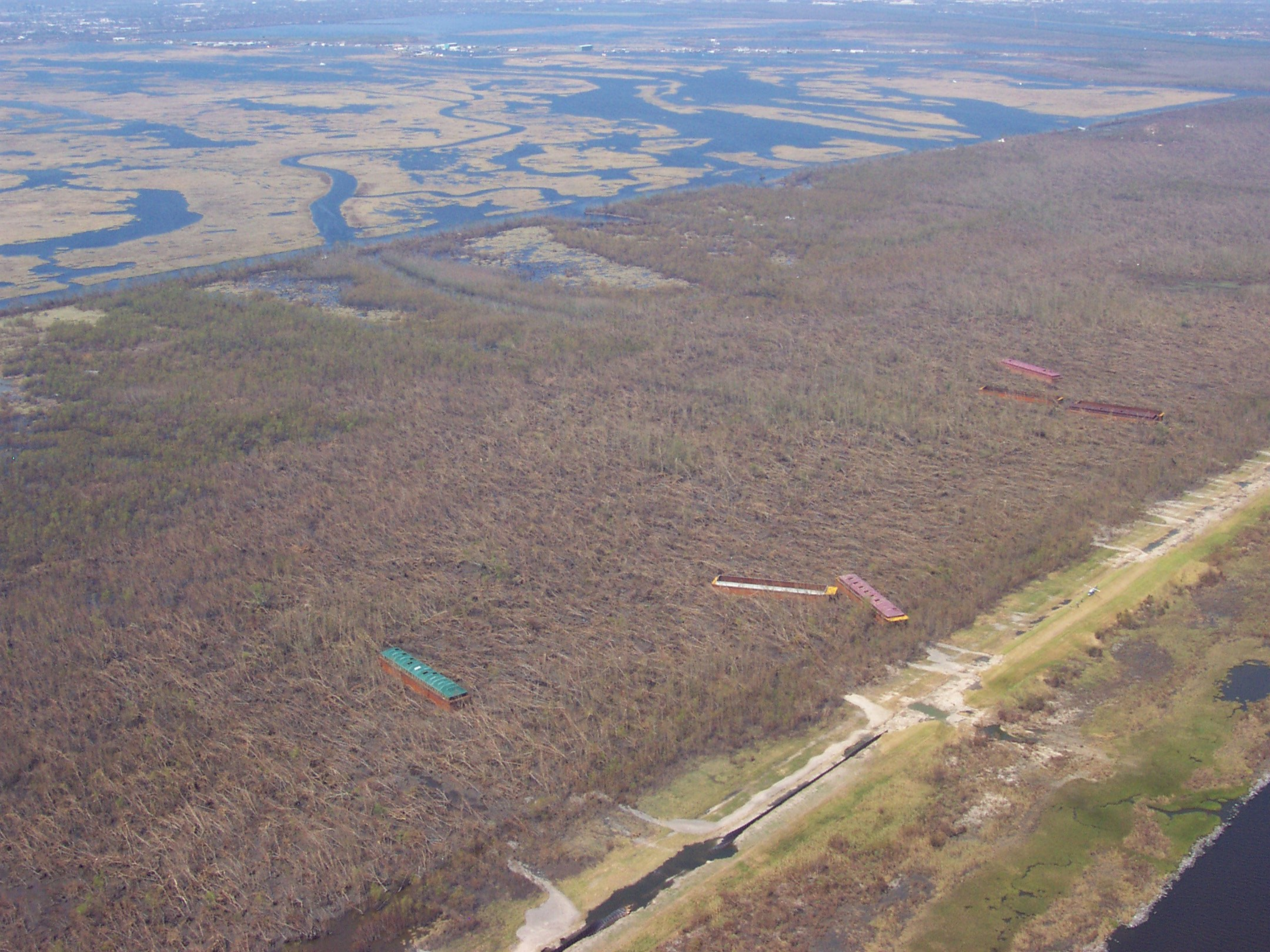
US Army Corps of Engineers ®

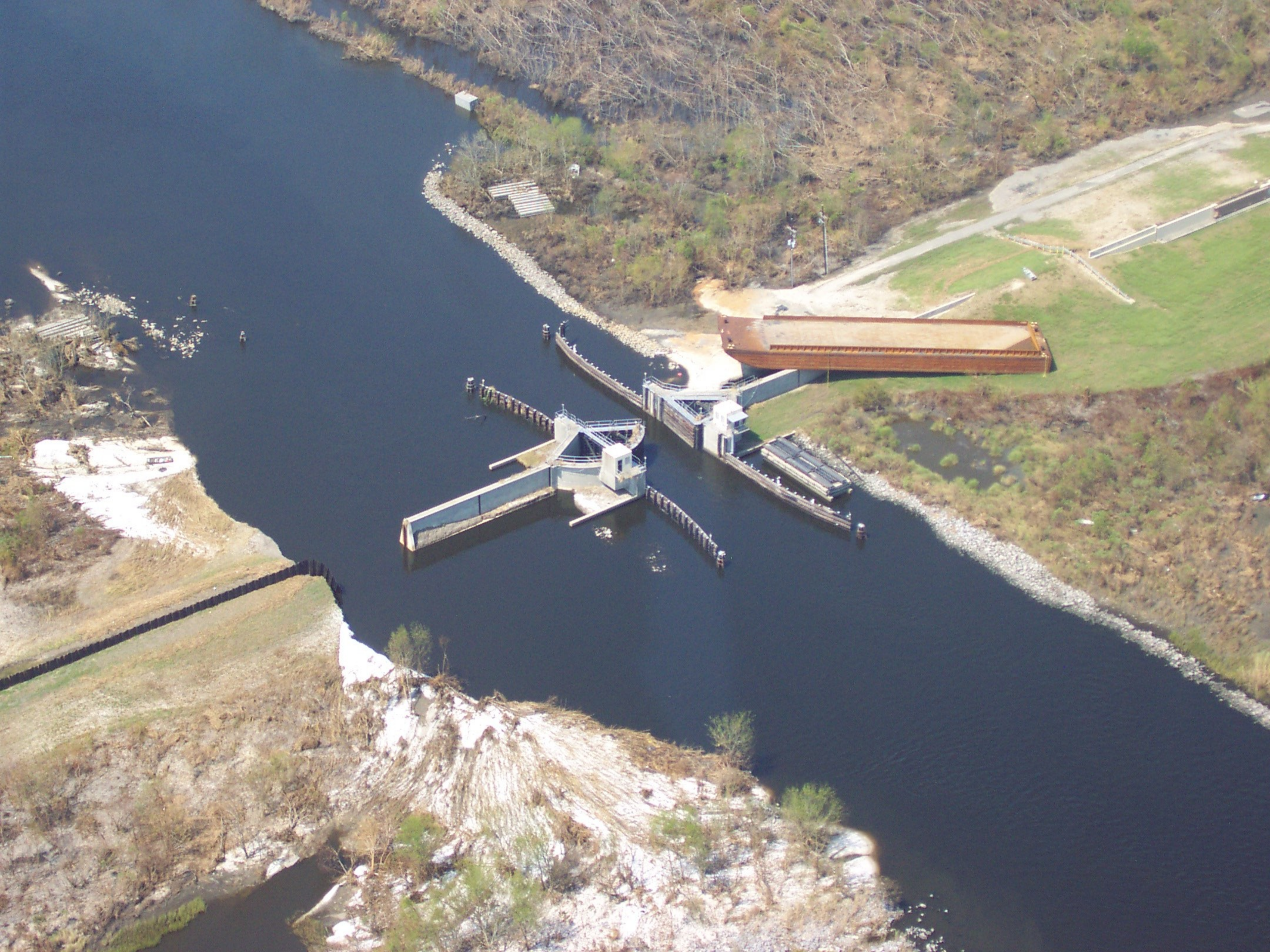


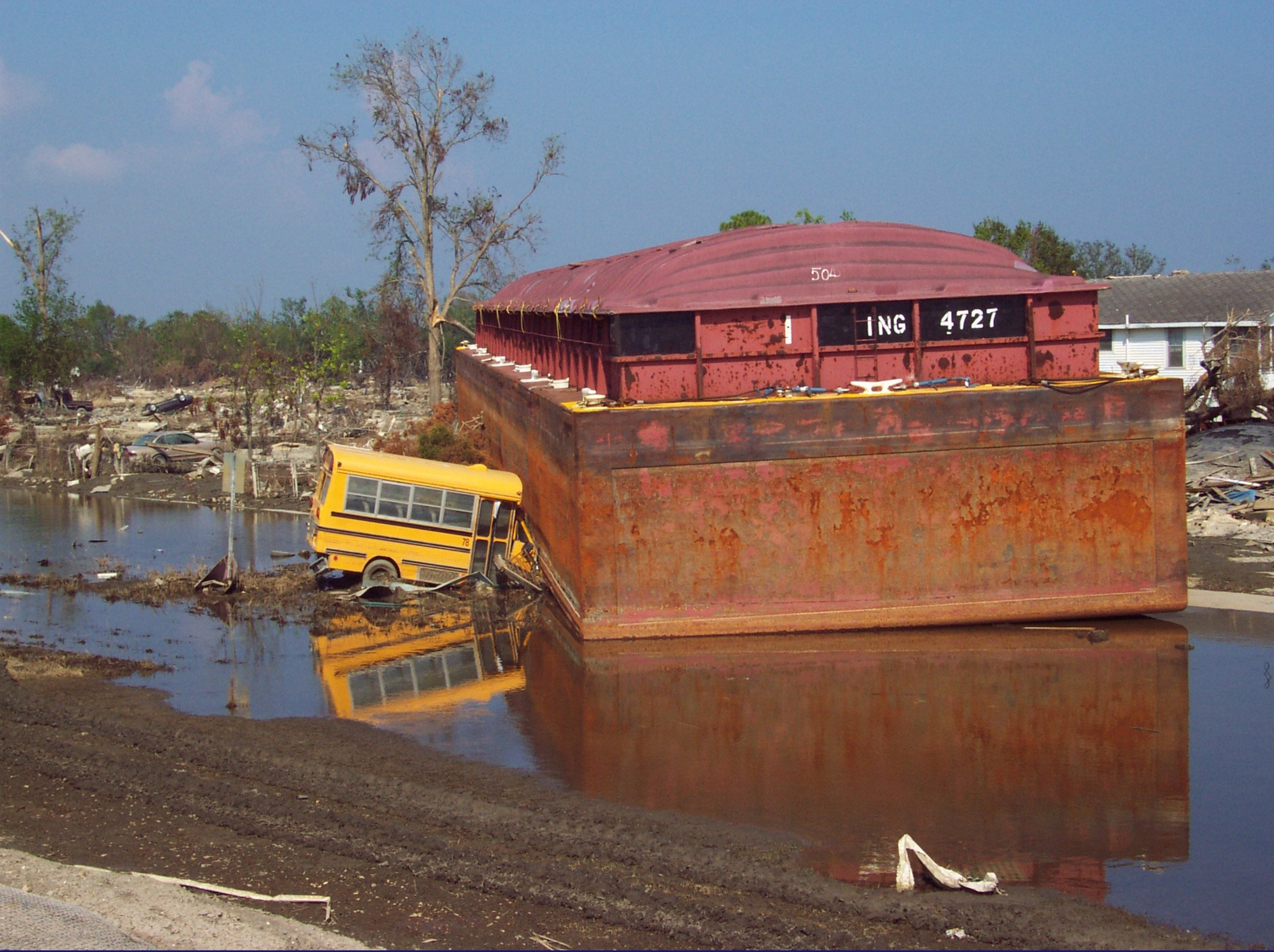


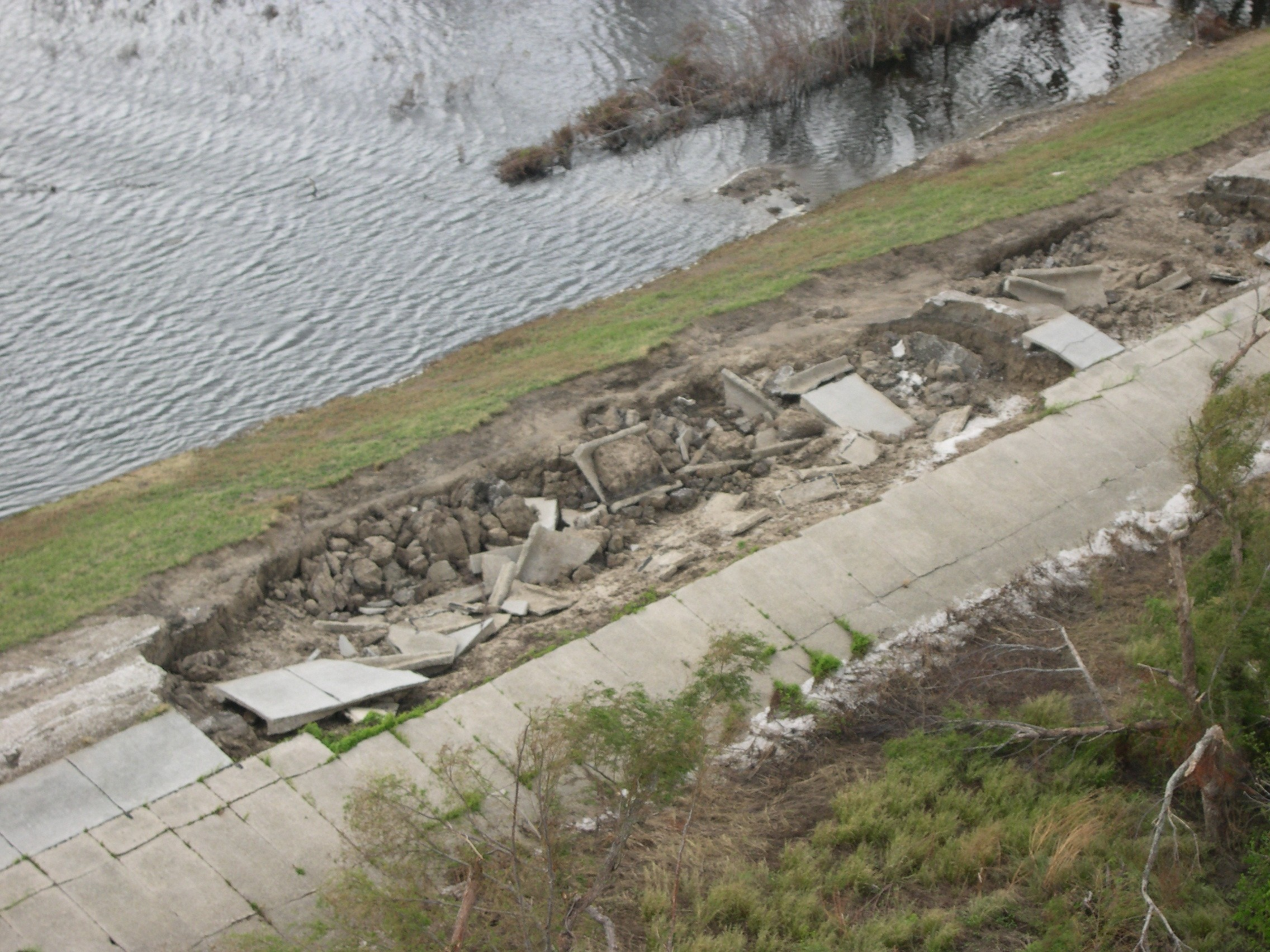






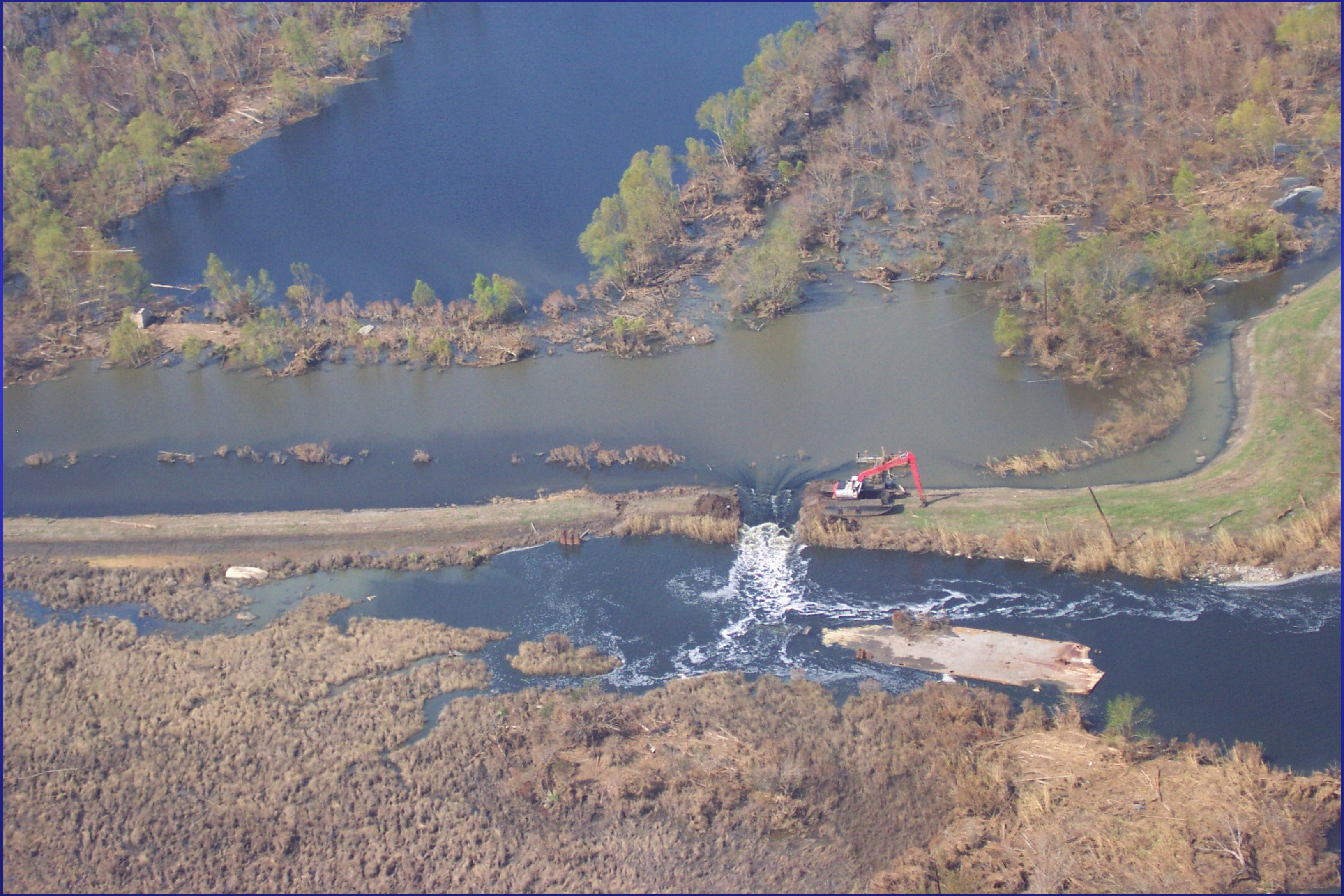



504
ING 4727
78



Task Force Unwatering

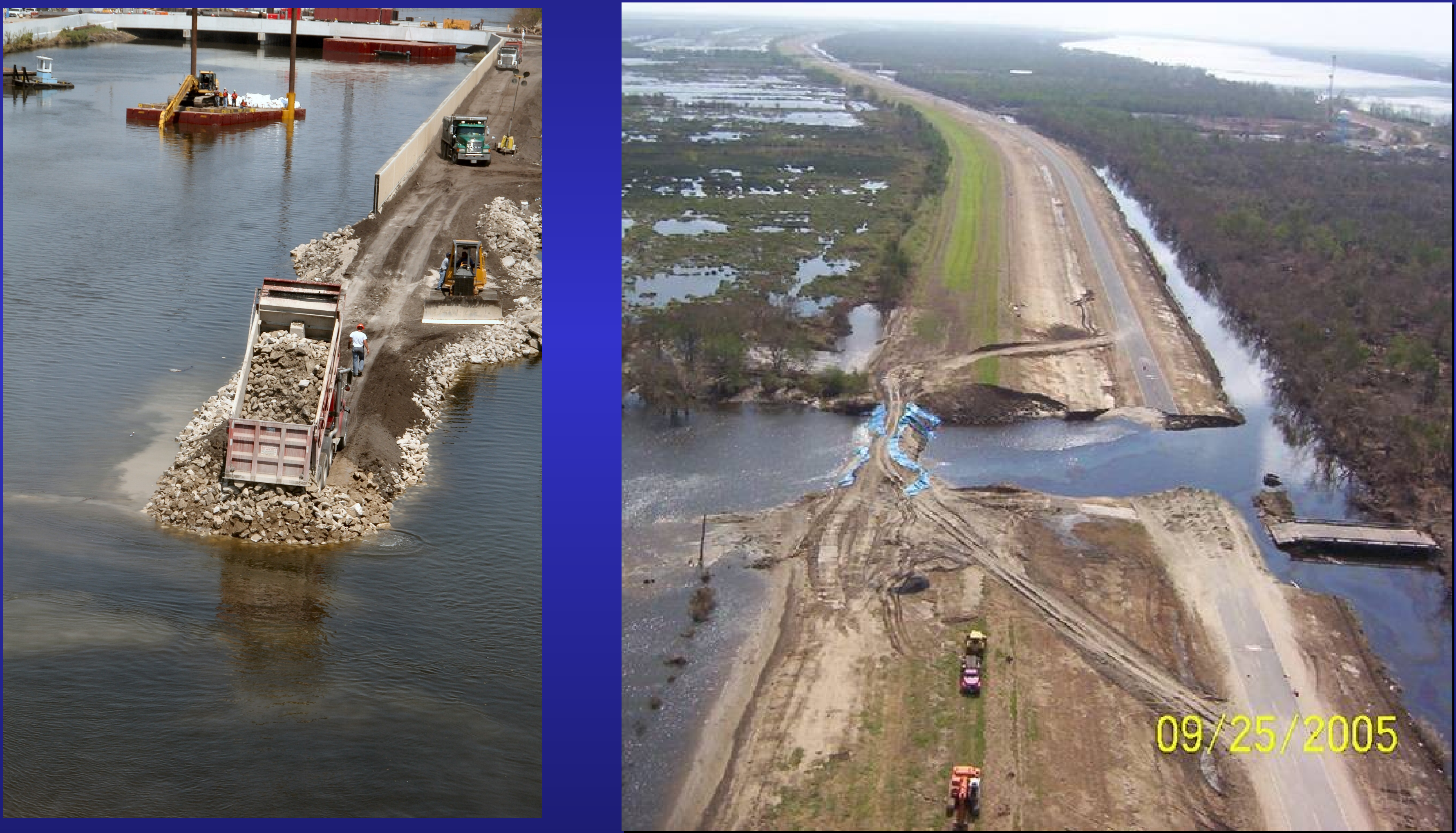
Basic Strategy



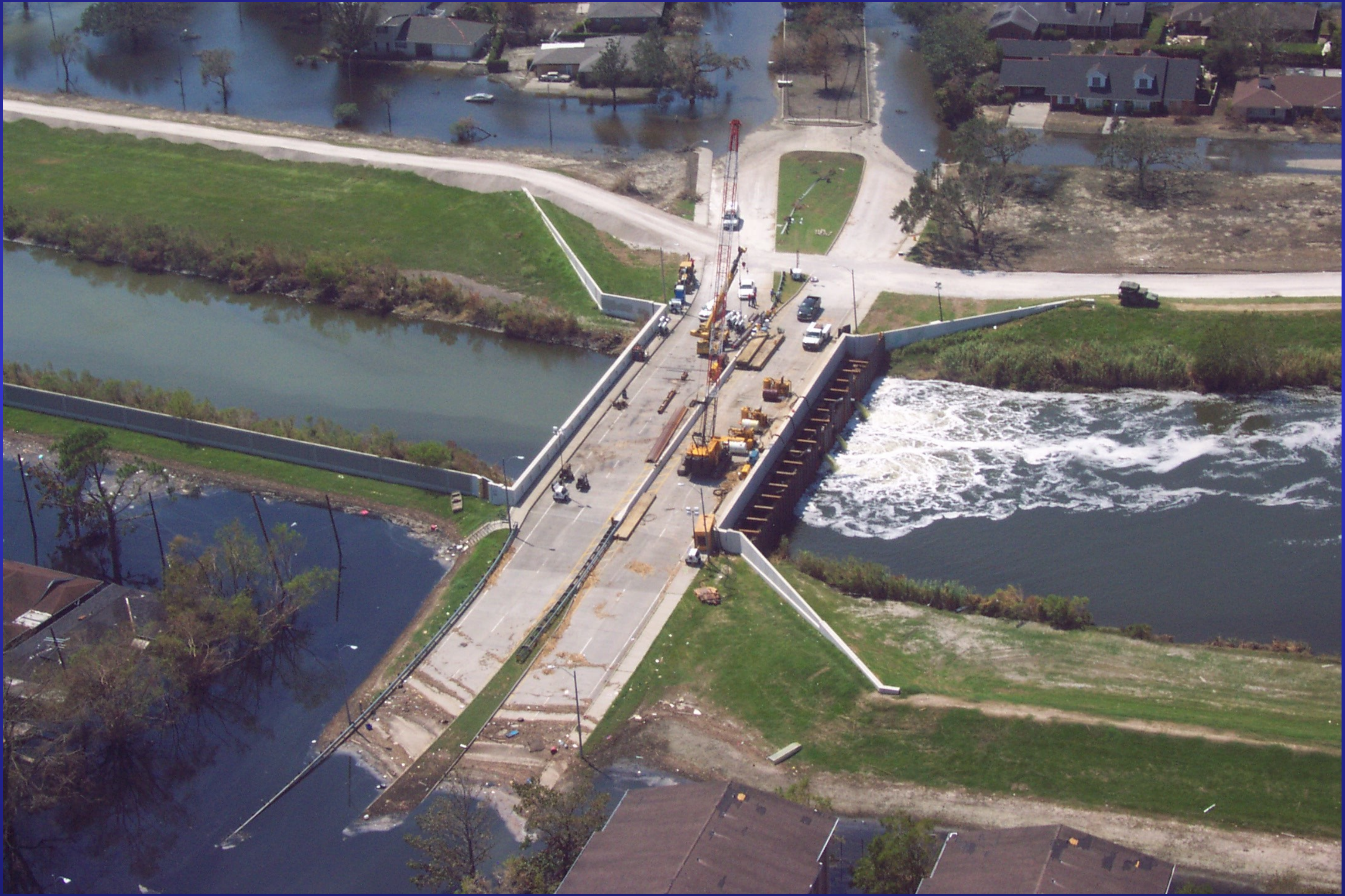
Basic Strategy

US Army Corps of Engineers
Emergency
Operations

Basic Strategy



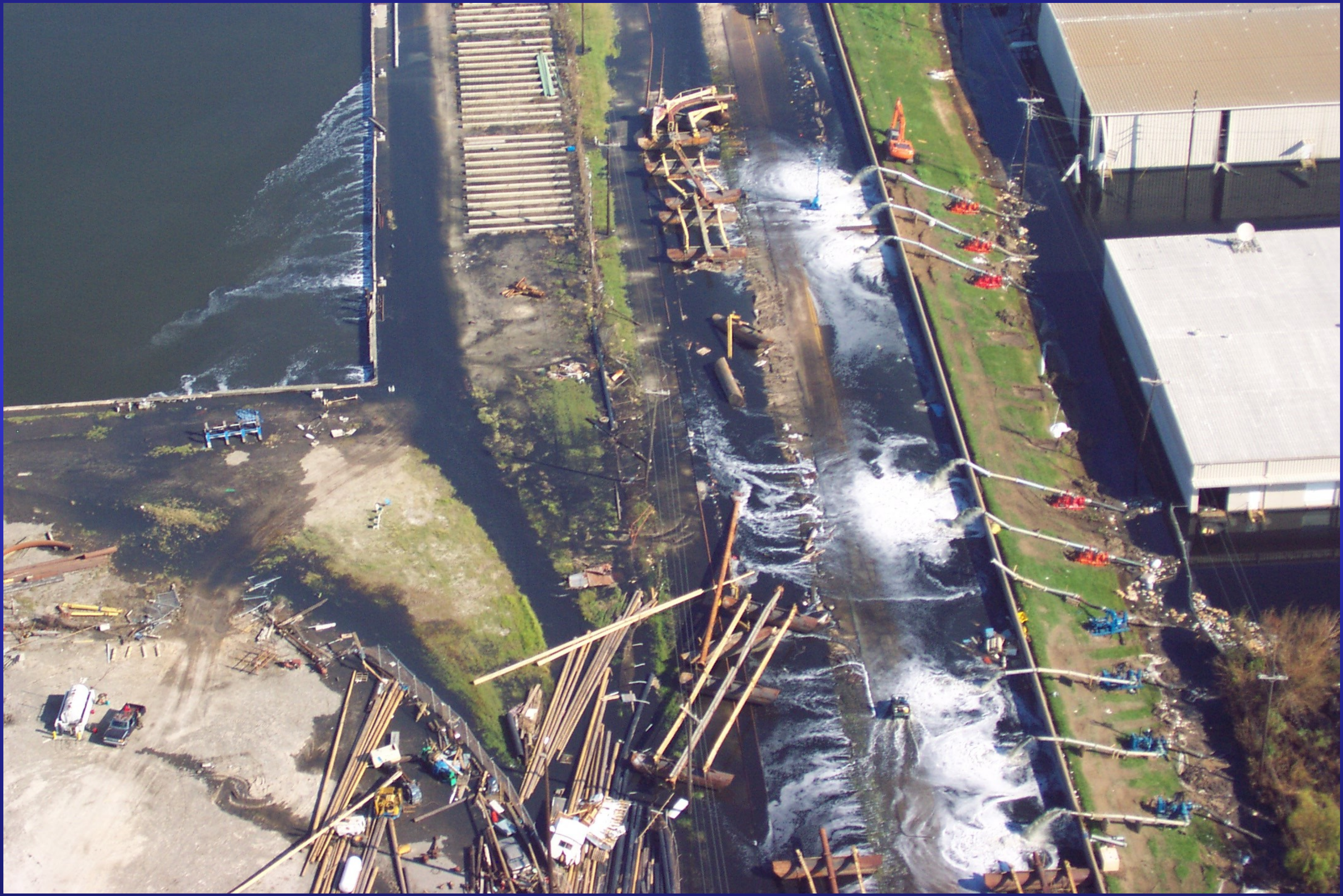
Basic Strategy



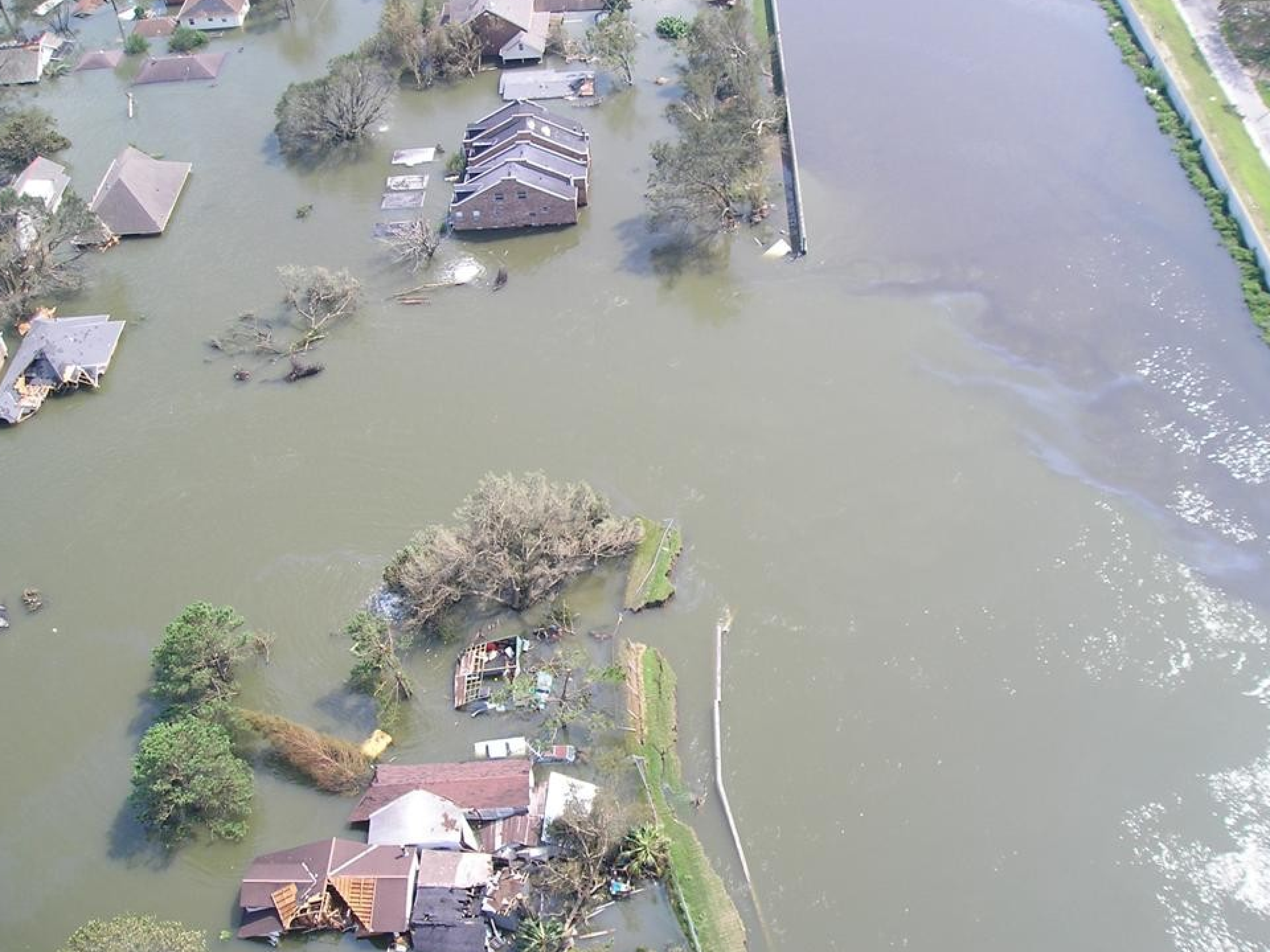
Basic Strategy

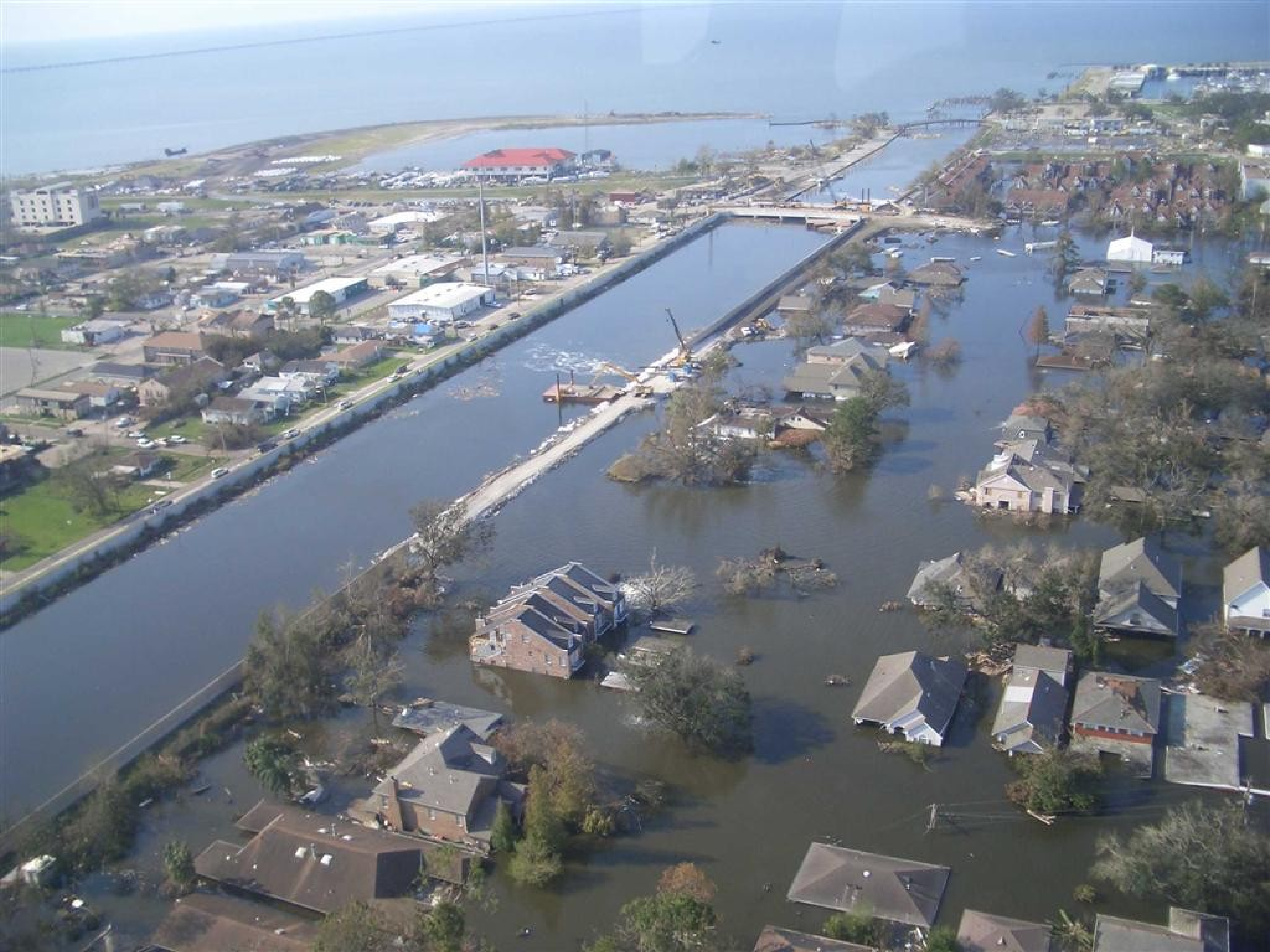
Basic Strategy

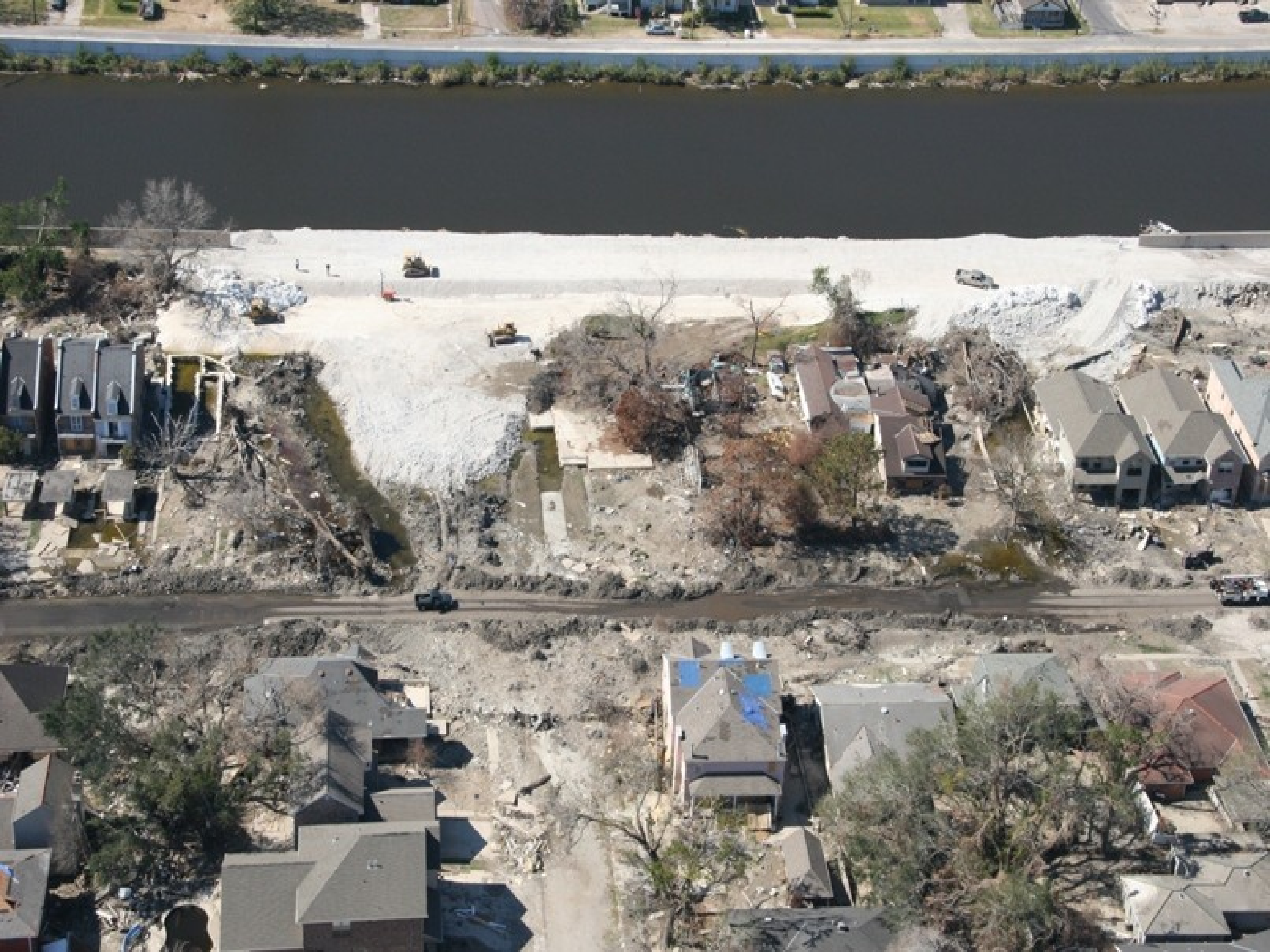
Basic Strategy

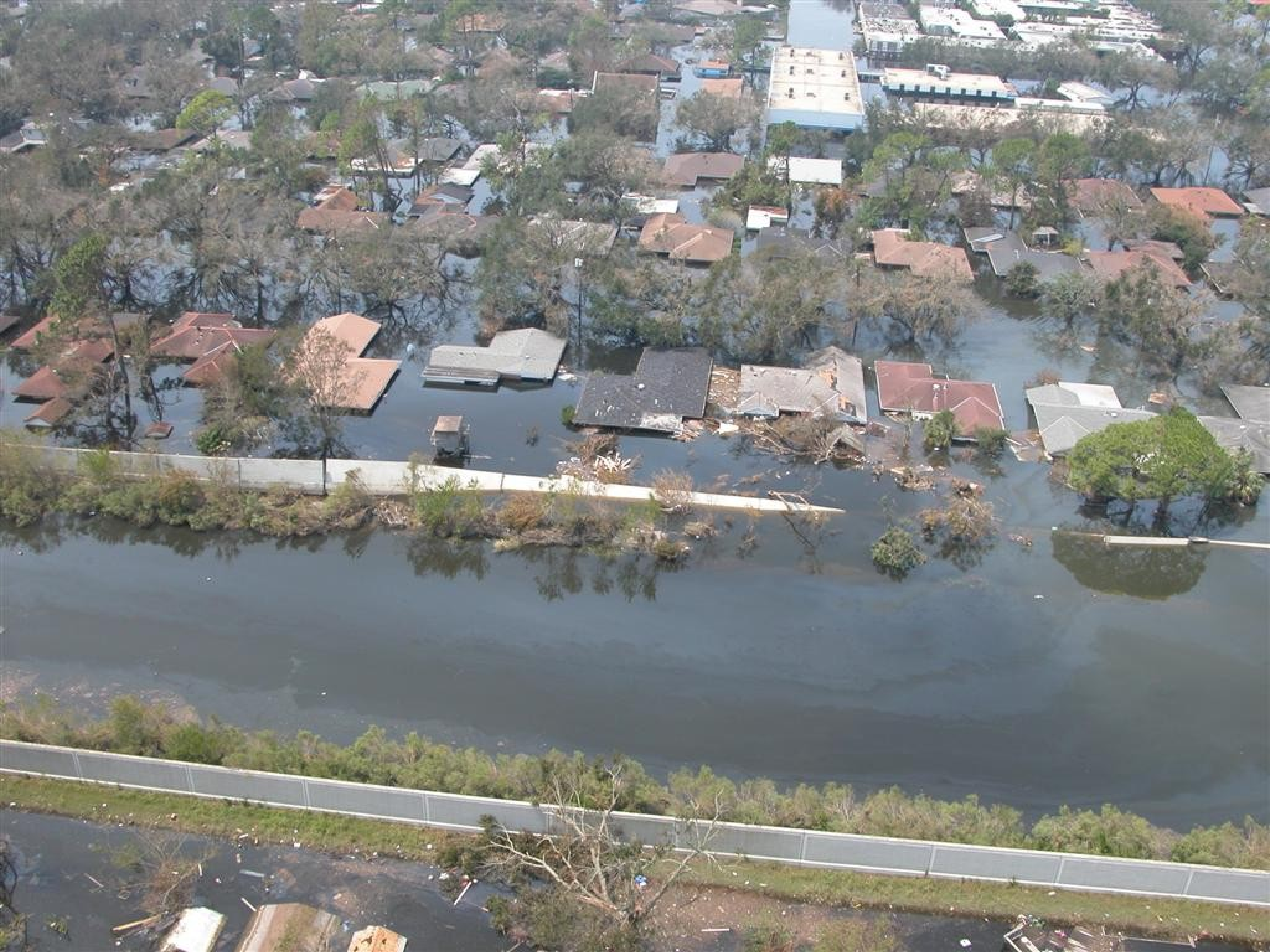


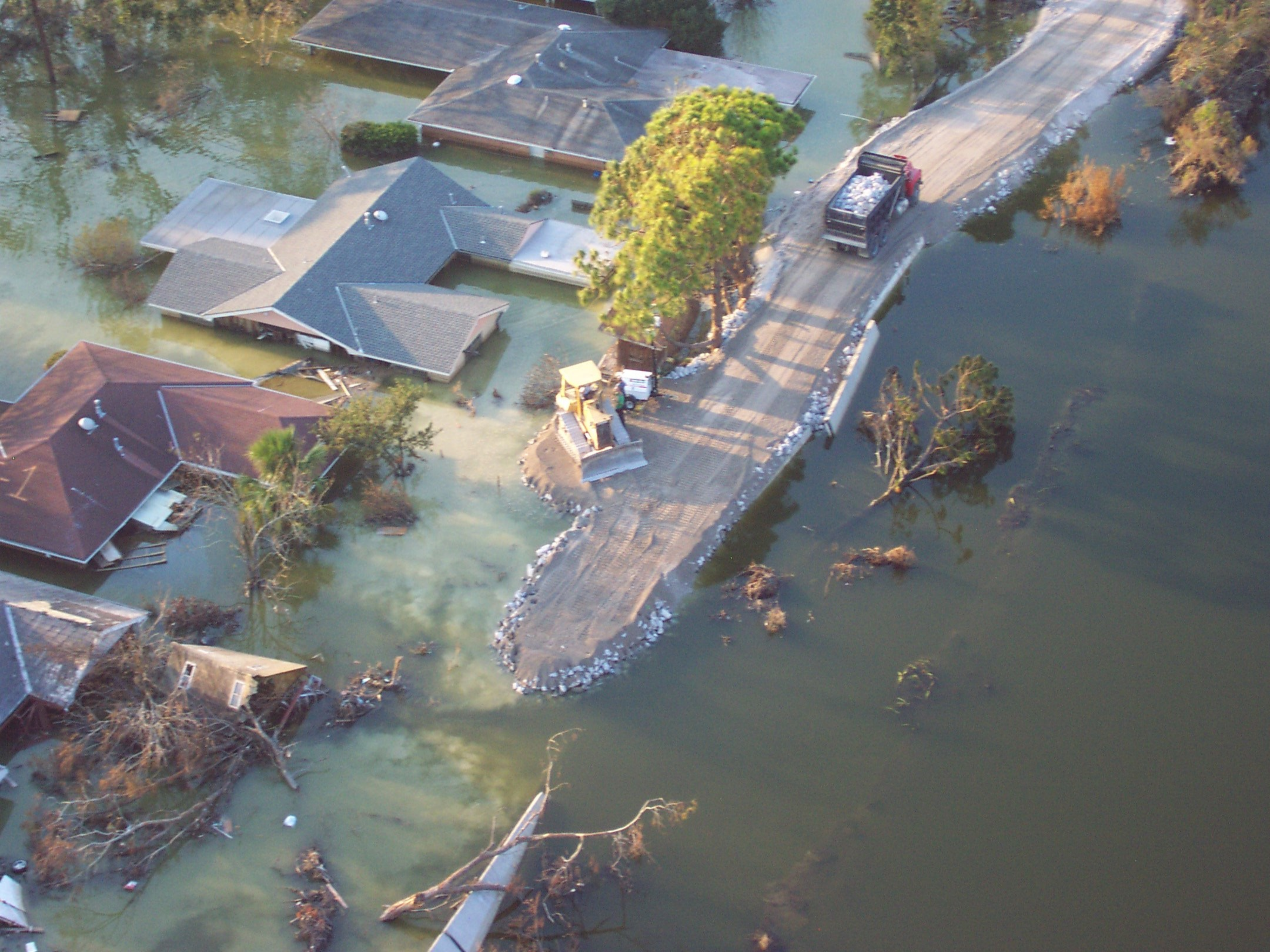
RESULTS

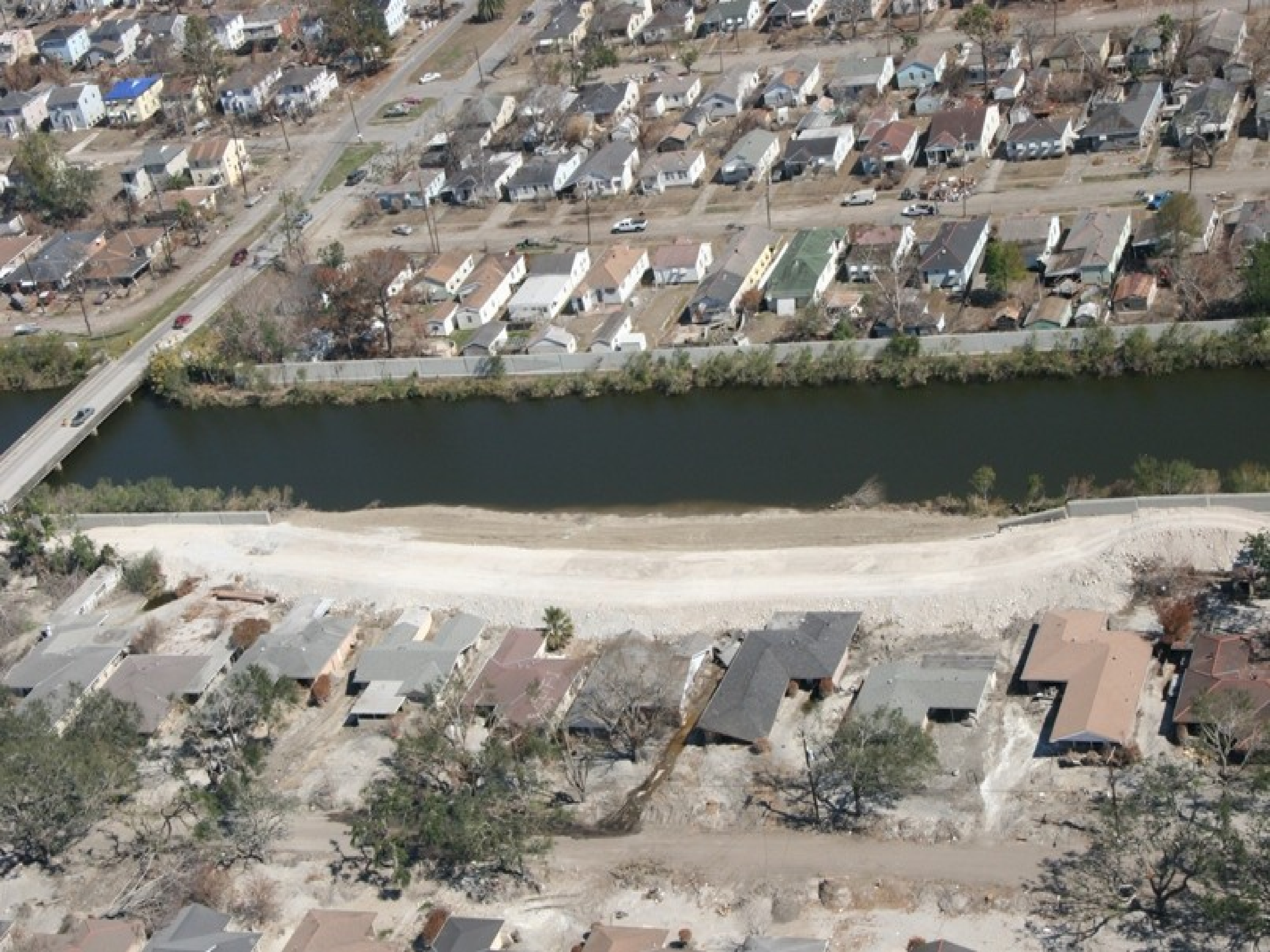


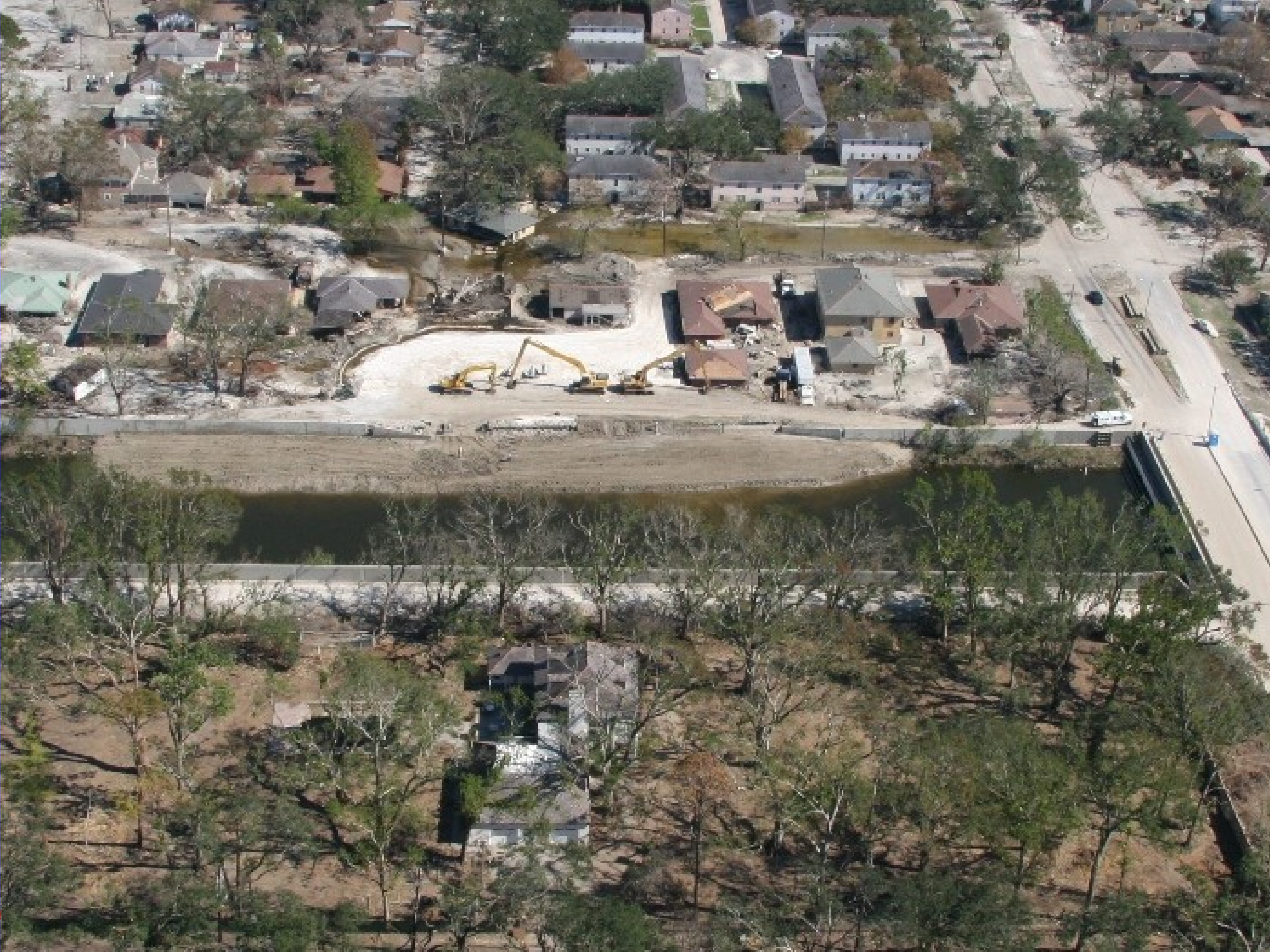


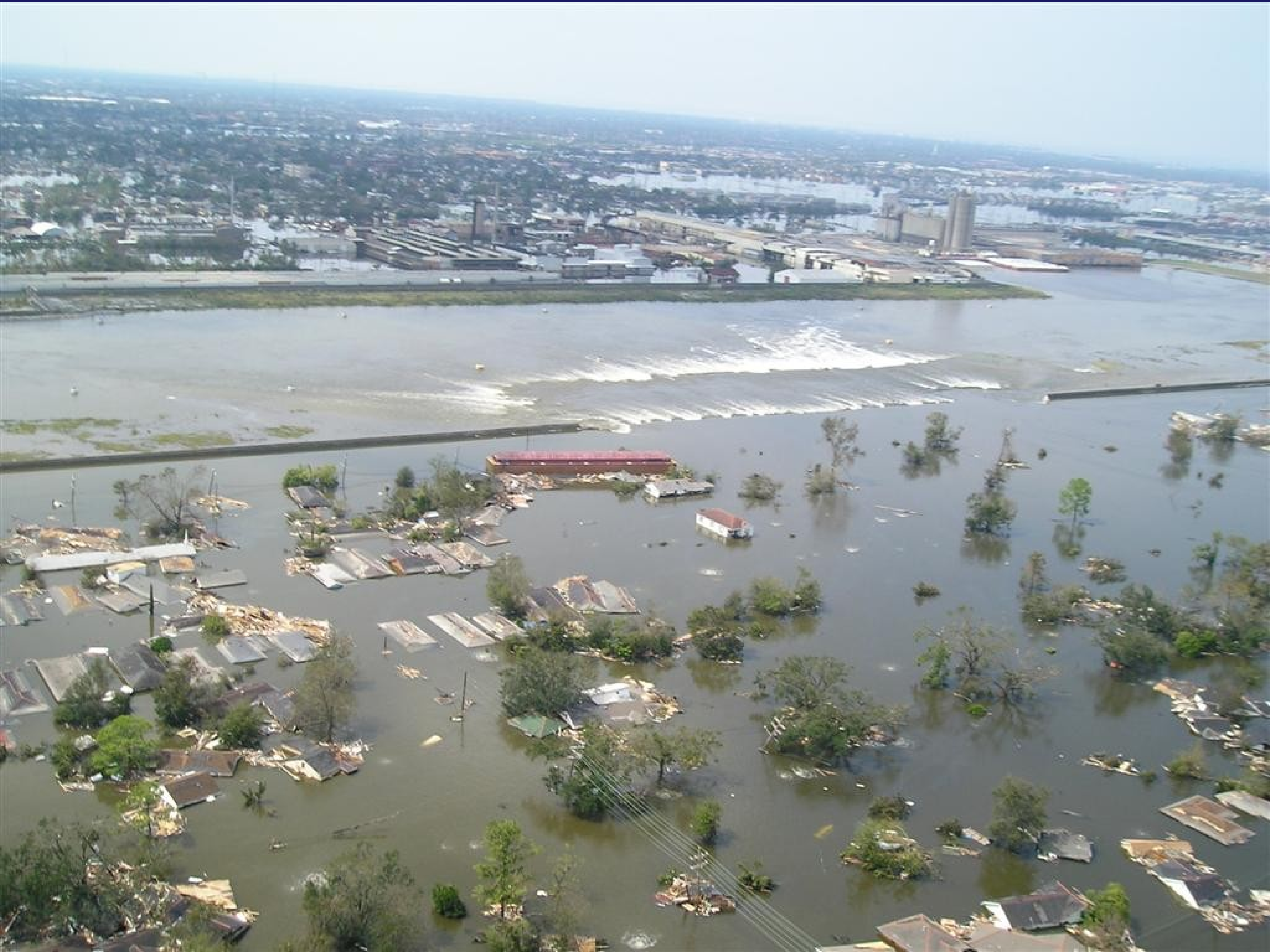


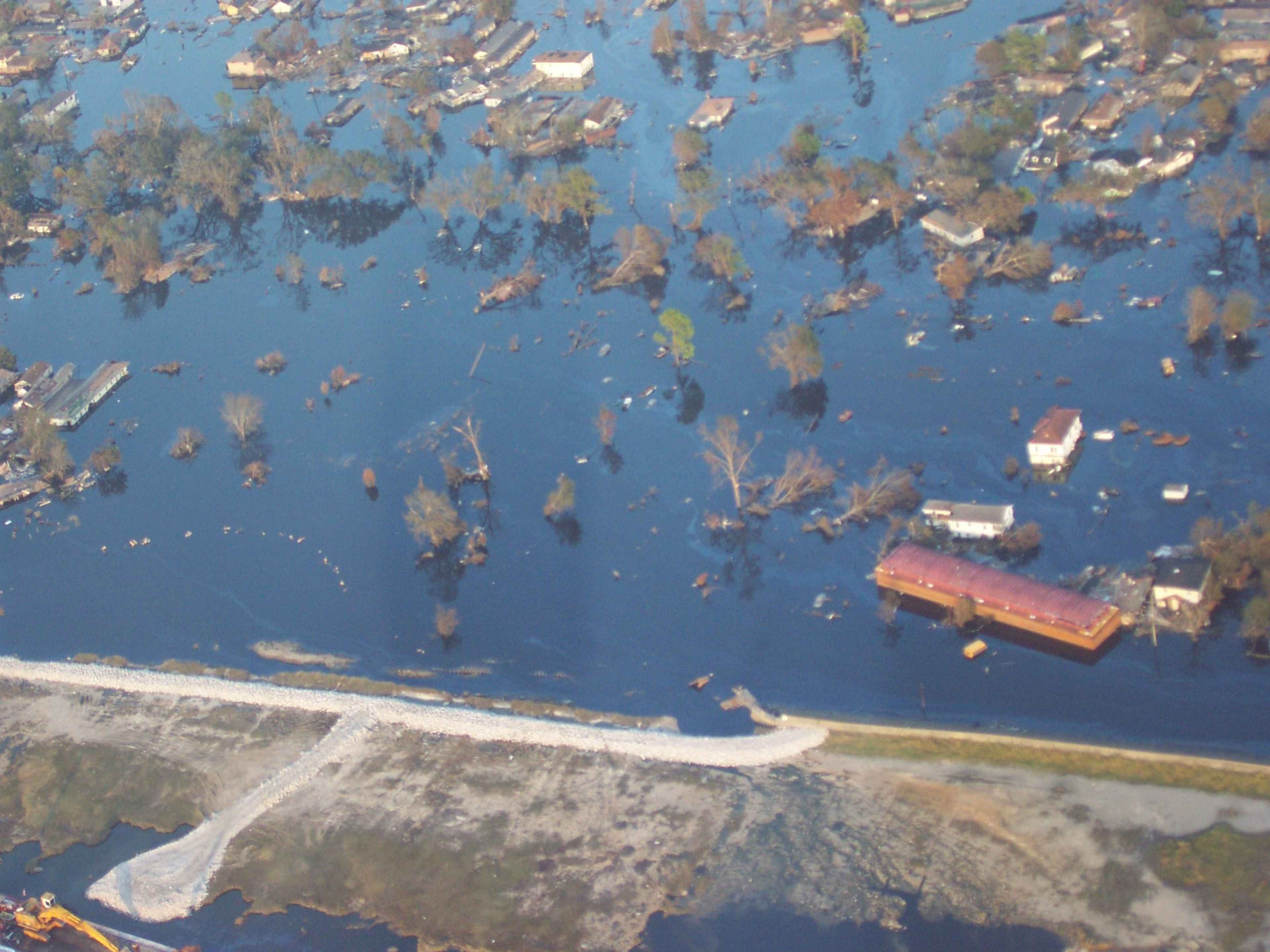


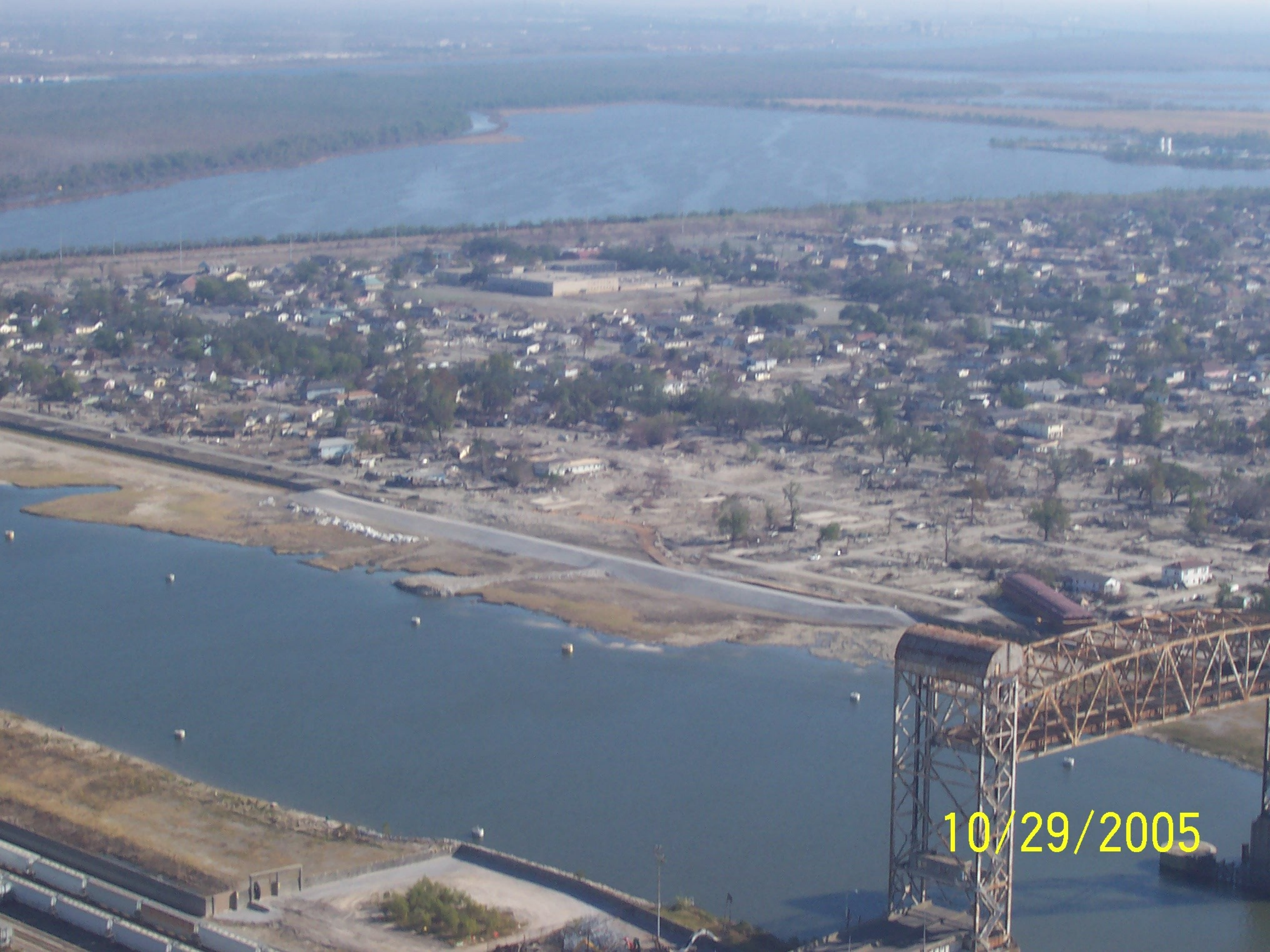











10/29/2005

TURBO
MAGNUM
CAUTION
Country Joe

Lessons Learned

MAERSK
SEALAND
SeaLand

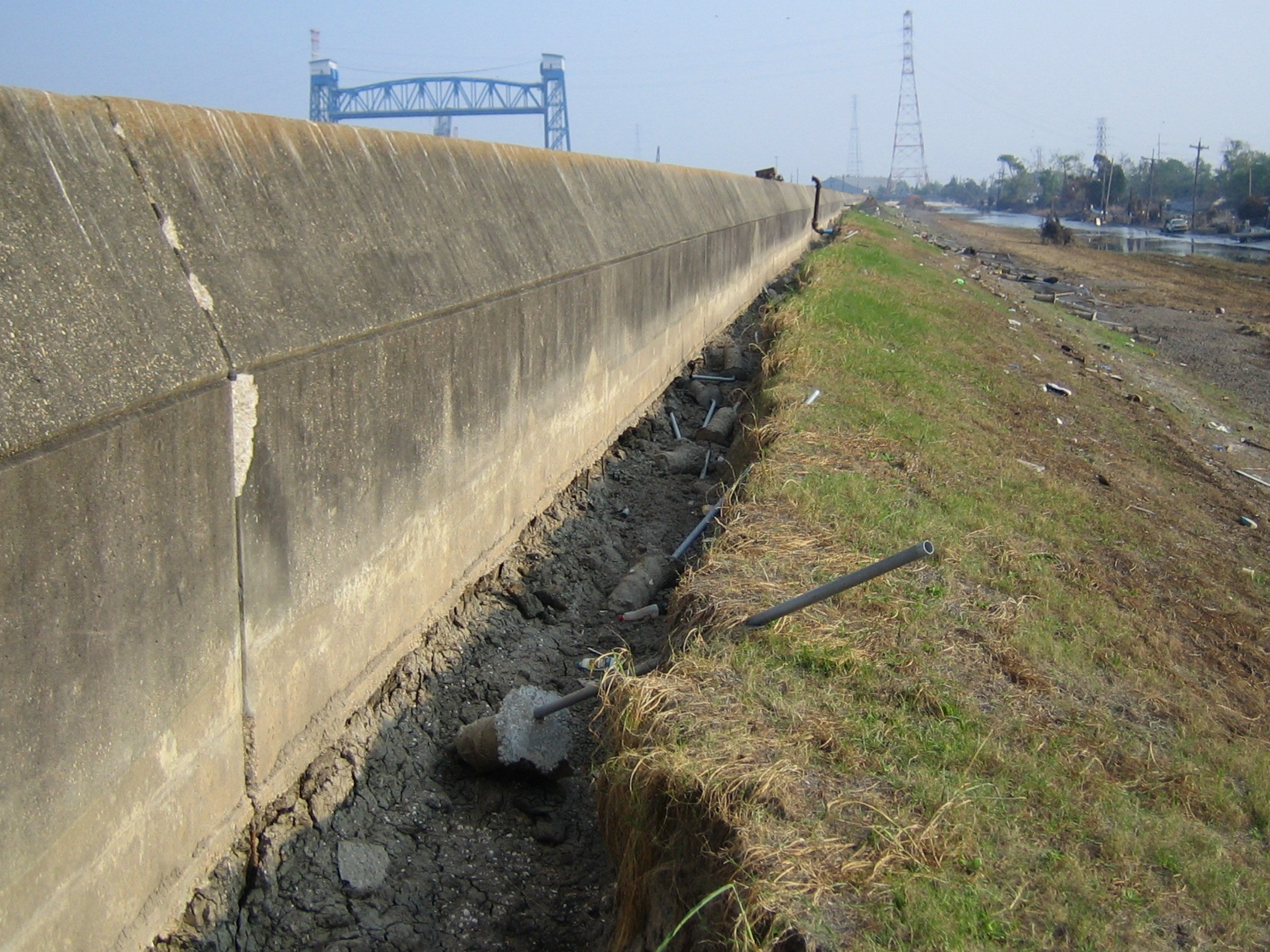
- Creation of Task Force Unwatering
- Information Demand/Management
- Manage by Parish/Drainage Basin
- Use of Temporary Pump Units
- Communication Challenges
- Environmental Coordination

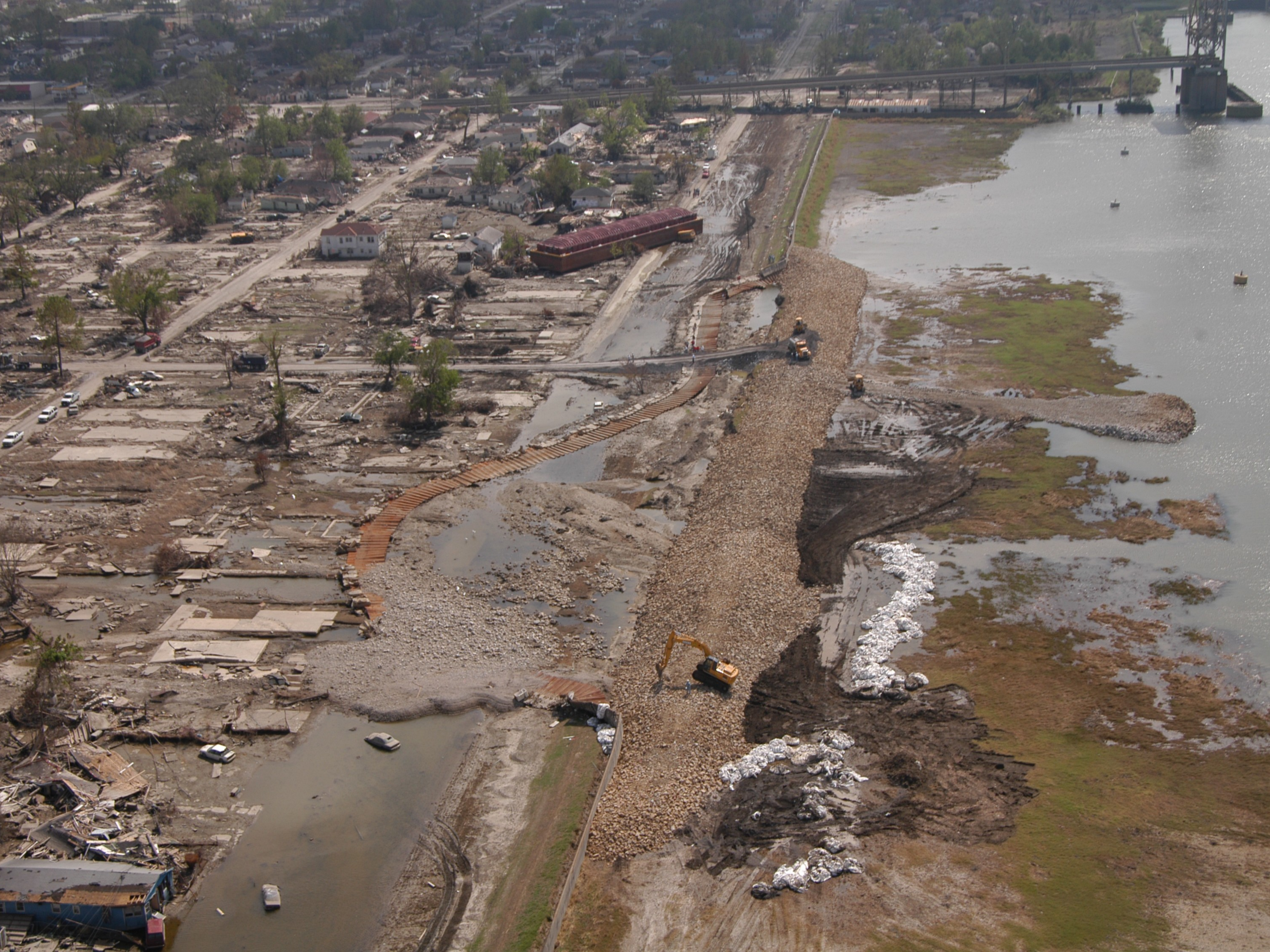
Drained 250+ Billion Gallons of Water

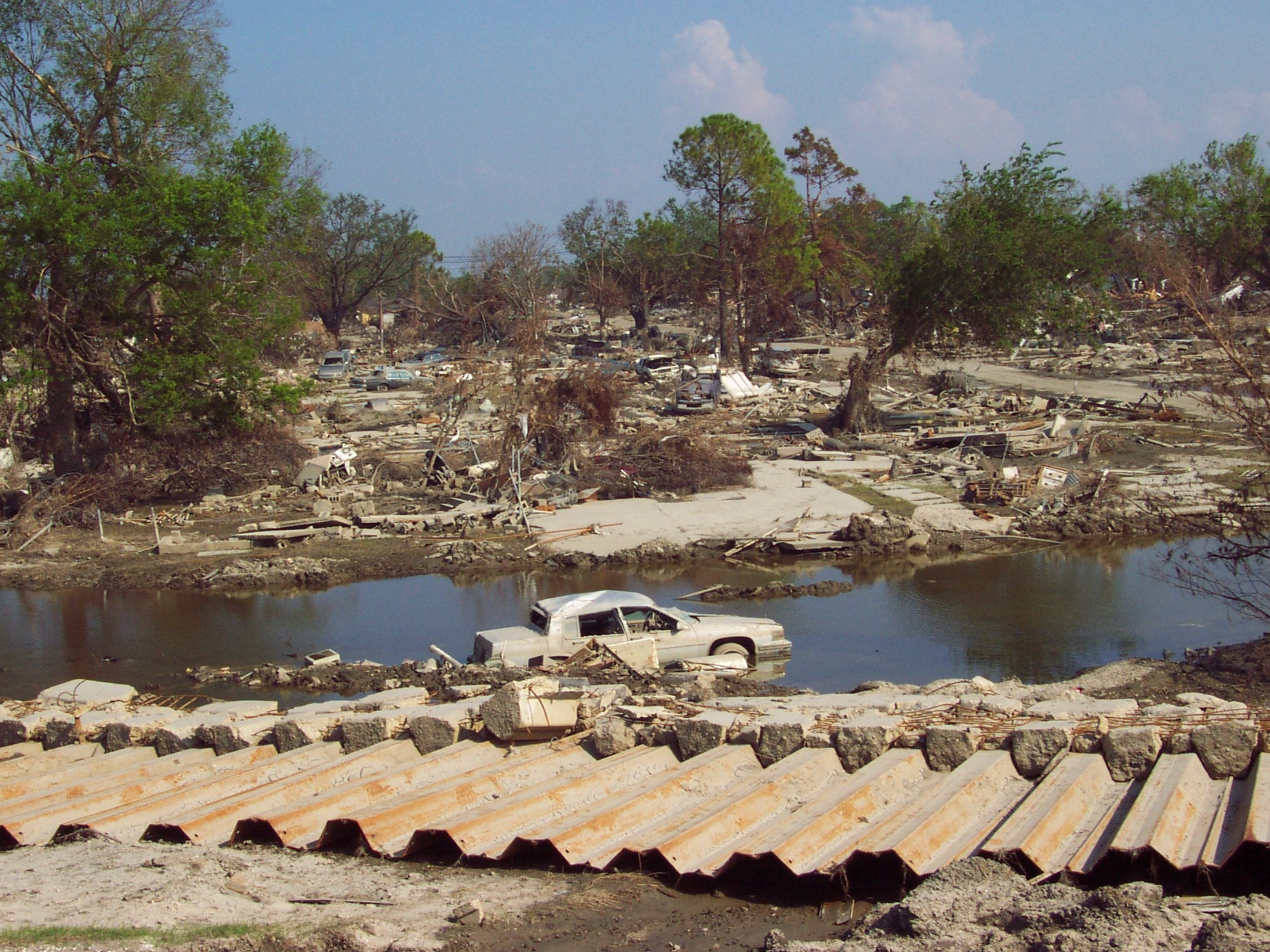
Repaired Nine Major Breaches

Provided Near Term Protection

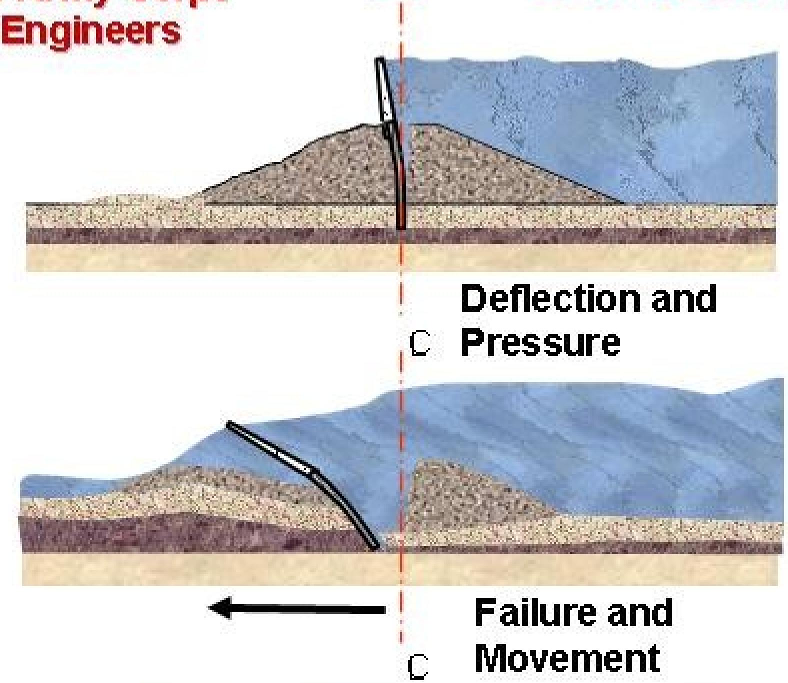
Floodwall
Failure Mechanisms







17th Street Breach Mechanism

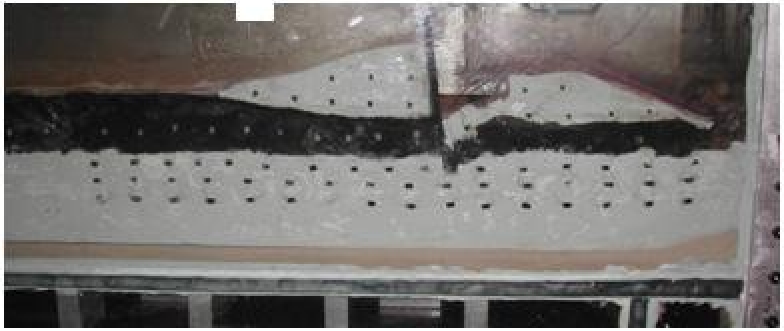


Deflection and Pressure

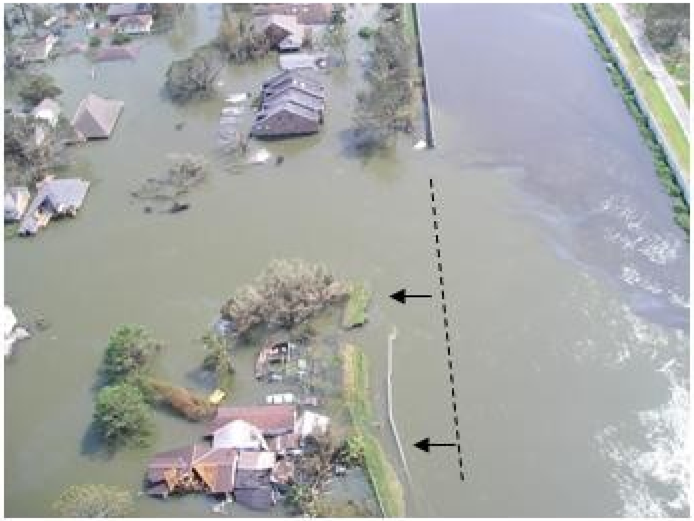
Failure and Movement

17th Street Canal Breach

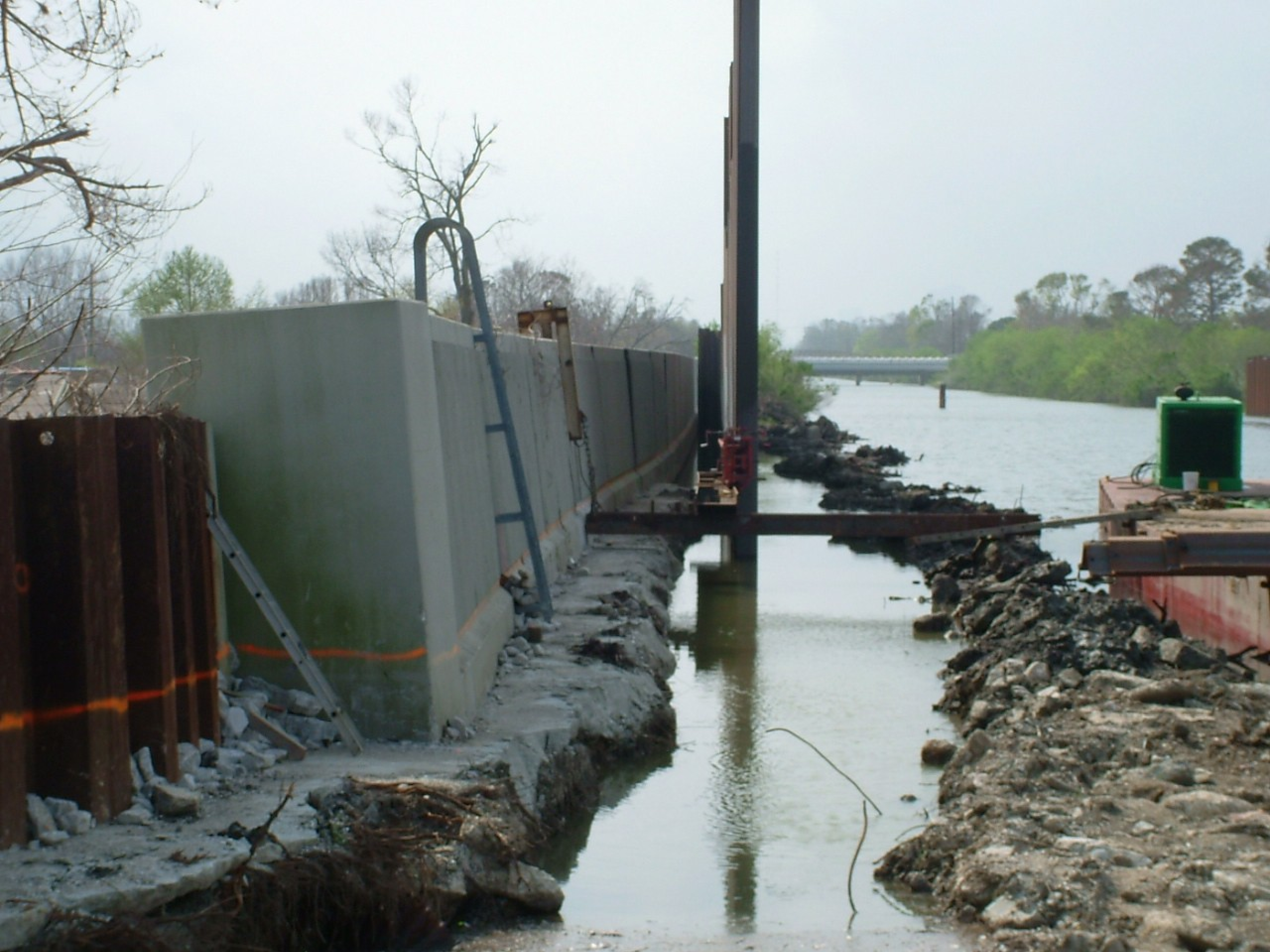
- Deflection of I–Wall by surge/waves
- Full hydrostatic pressure along wall
- Weak clay at levee toe causes
  failure in subsurface clay layer
- Soil block from wall back displaced



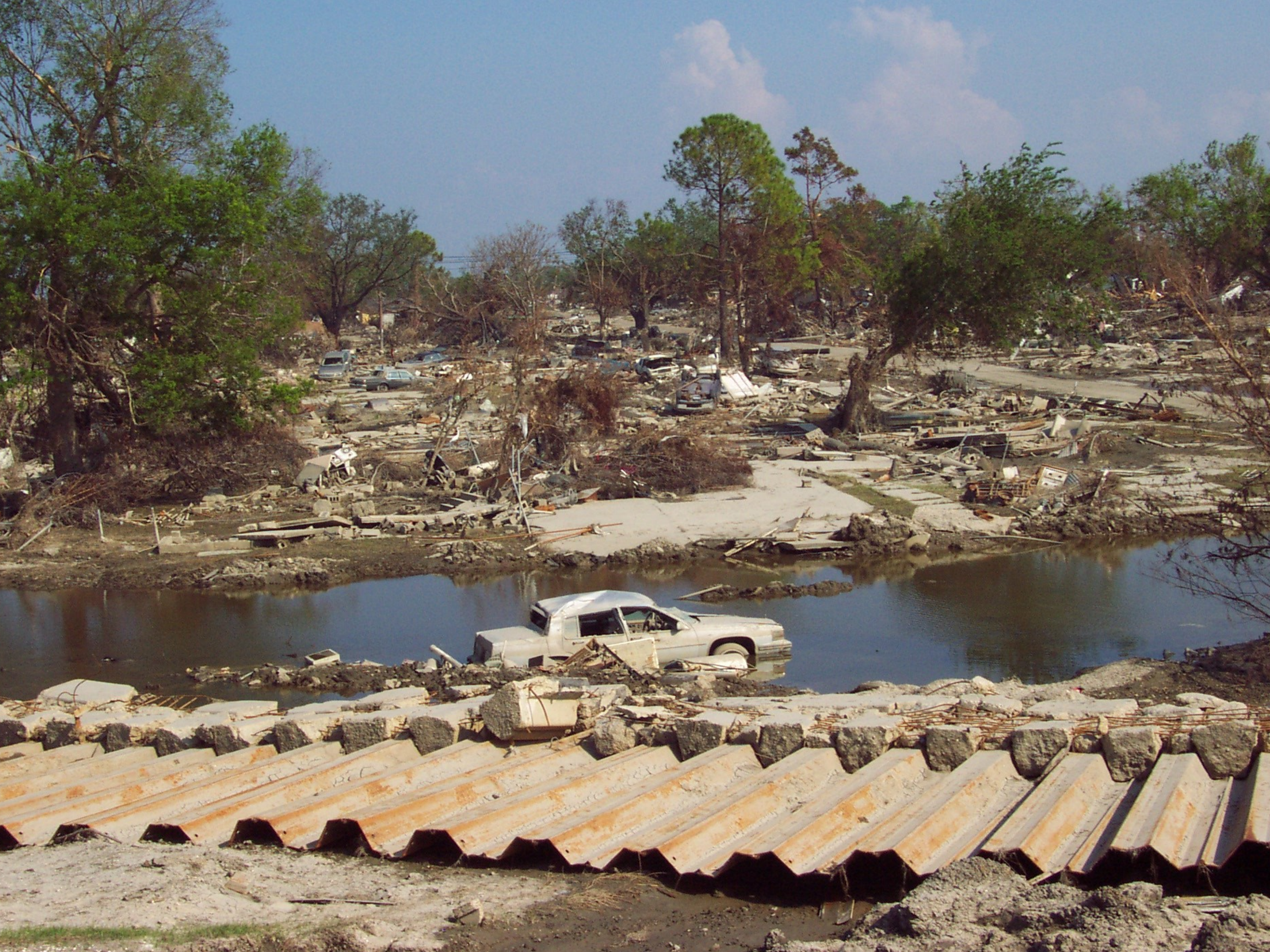
Confirmation in Centrifuge



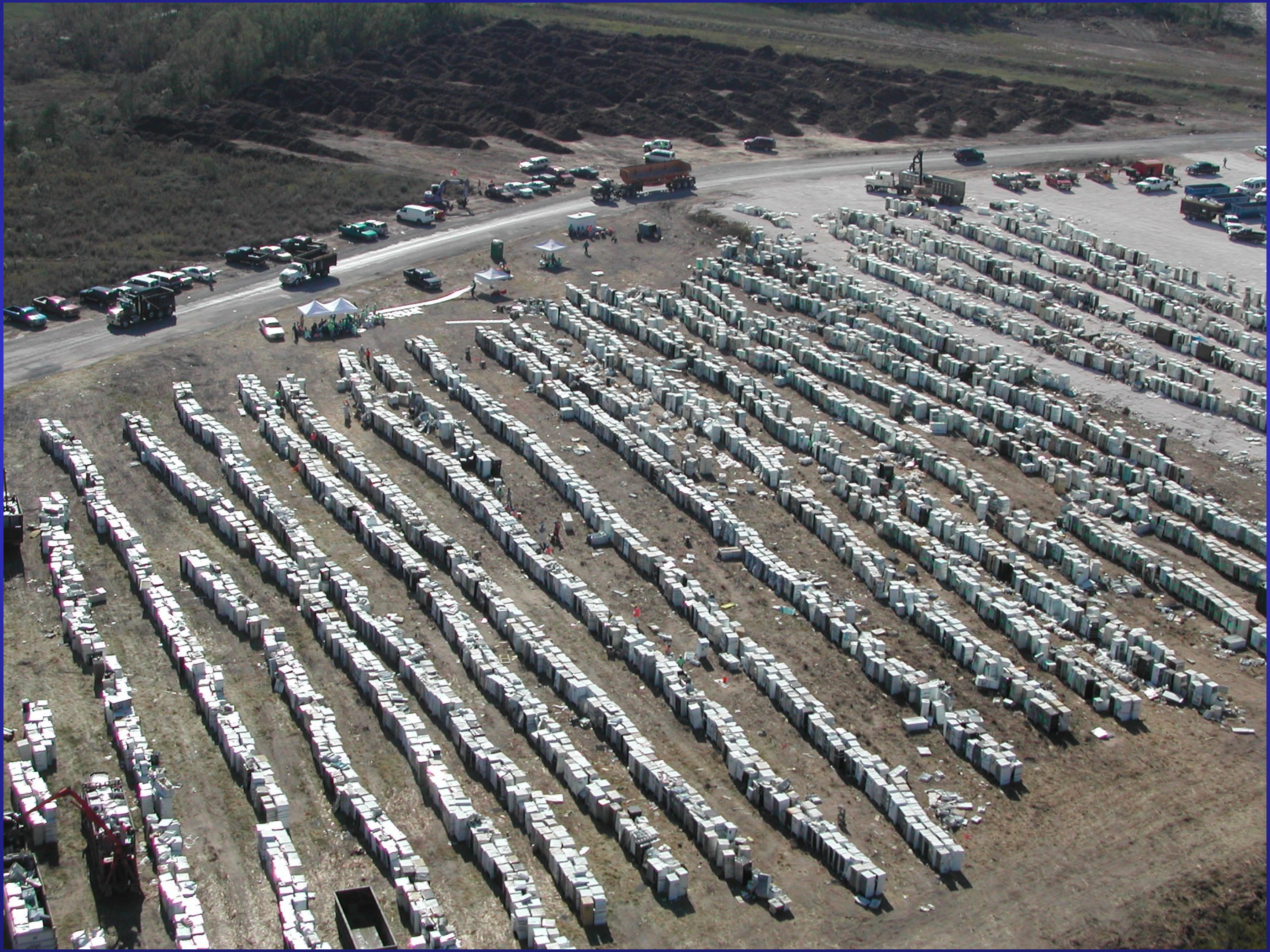
Displacement of wall and part of levee

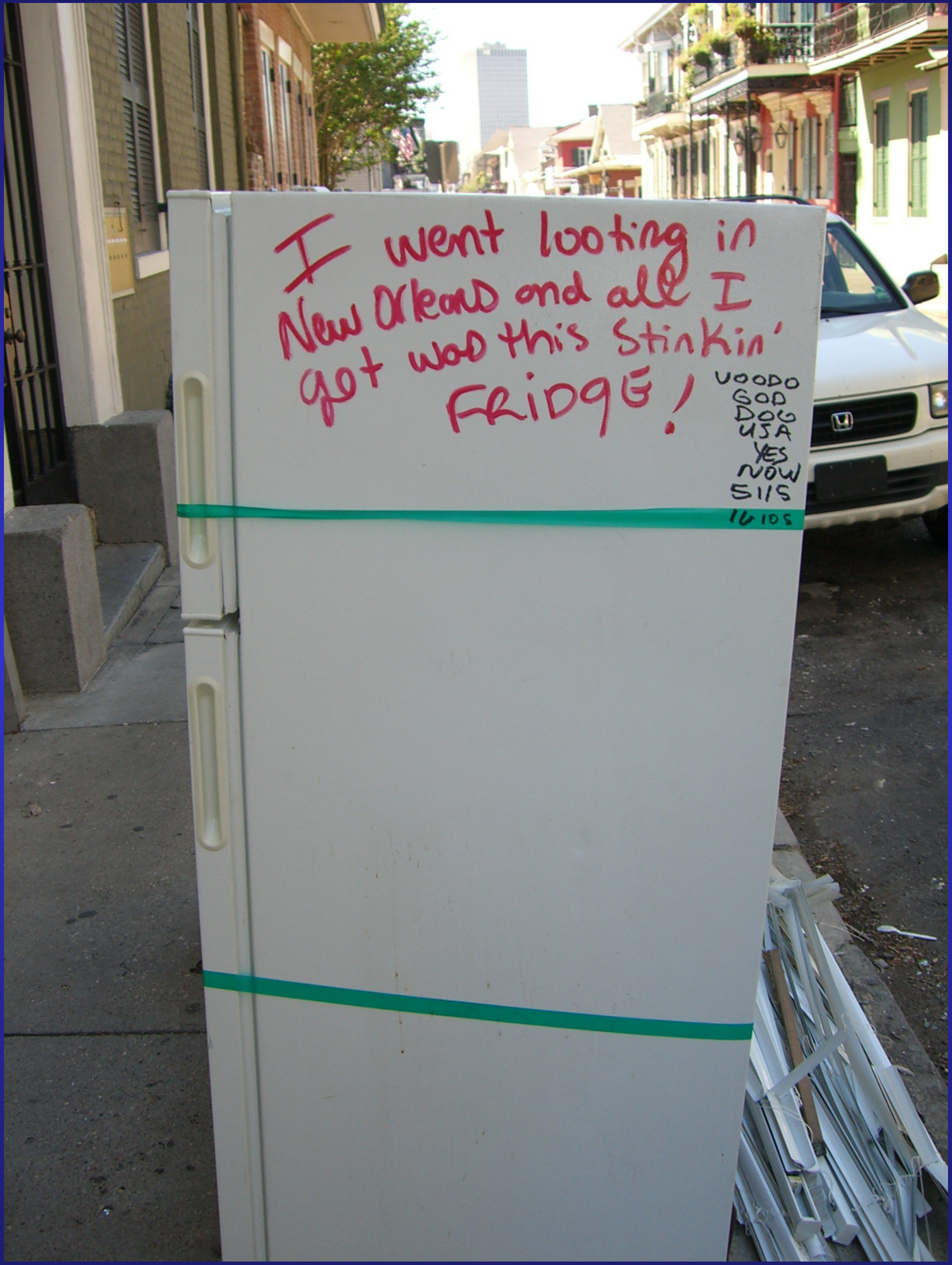


The Big Easy



Refrigerator Graveyard




I went looting in
New Orleans and all I
got was this Stinkin'
FRIDGE!
VOODO
GOD
DOG
USA
YES
NOW
5/15
16 105

Buy 2 Maggots
Get 10,000
Free
FRIGIDAIRE
FRONT

MY
TUMMY
HURTS

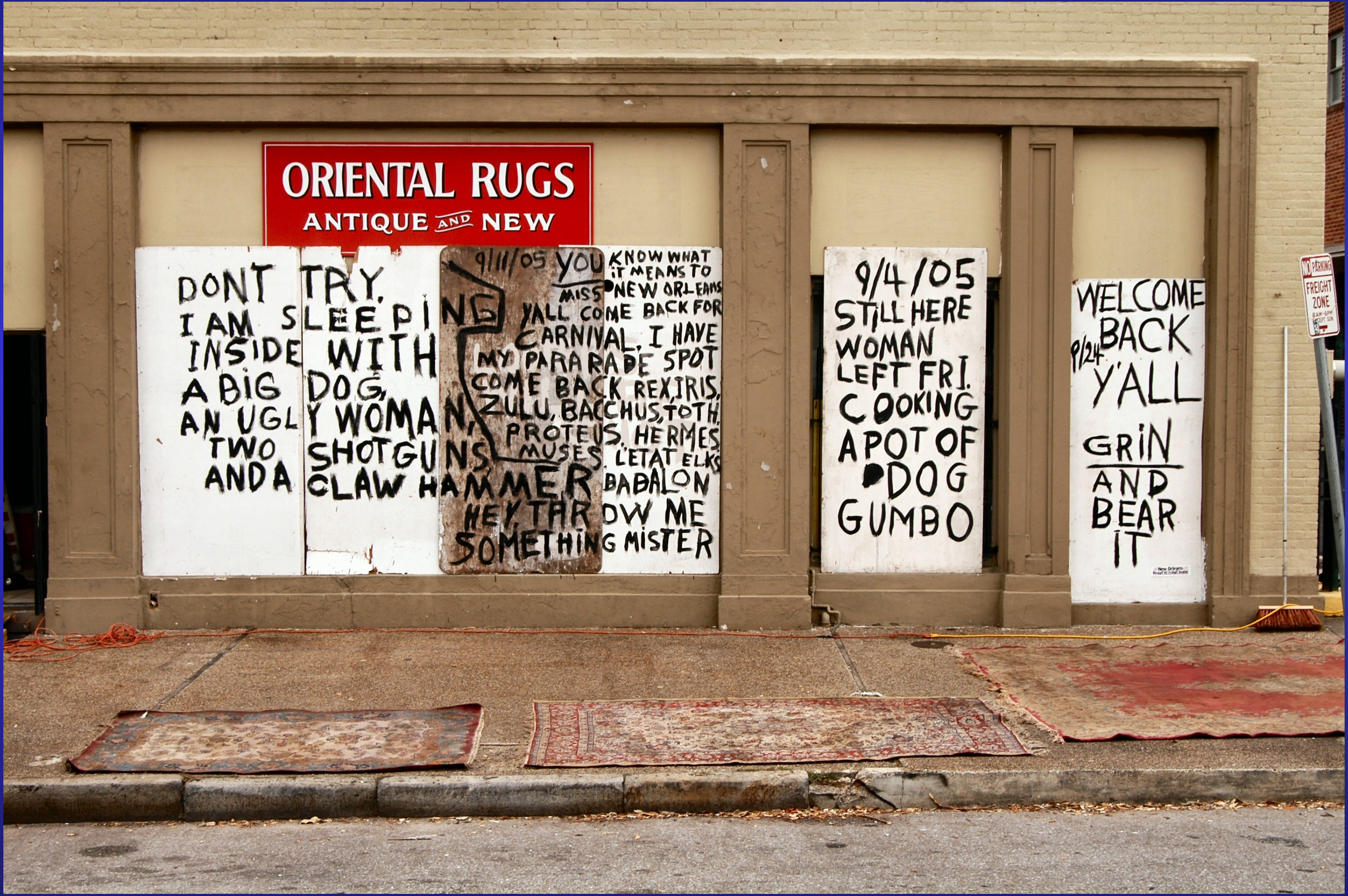
U.S.ARMY

CNN
Hi MITC
xoxoxo
-Soledad

US Army Corps of Engineers ®

Hi Mitc
xoxoxo
-Soledad

US Army Corps of Engineers ®


ORIENTAL RUGS
ANTIQUE AND NEW
DONT TRY, I AM SLEEPING INSIDE WITH A BIG DOG, AN UGLY WOMAN, TWO SHOTGUNS AND A CLAW HAMMER
9/11/05 YOU KNOW WHAT IT MEANS TO MISS NEW ORLEANS YALL COME BACK FOR CARNIVAL. I HAVE MY PARARADE SPOT COME BACK REX, IRIS, ZULU, BACCHUS, TOTH. PROTEUS, HERMES, MUSES, L'ETAT, ELKS, BABALON HEY THROW ME SOMETHING MISTER
9/4/05 STILL HERE WOMAN LEFT FRI. COOKING A POT OF DOG GUMBO
WELCOME BACK 9/24 Y'ALL GRIN AND BEAR IT
NO PARKING FREIGHT ZONE

One Team: Relevant, Ready, Responsive, Reliable

US Army Corps
of Engineers ®

QUESTIONS?

One Team: Relevant, Ready, Responsive, Reliable

Backups

Task Force Guardian

www.mvn.usace.army.mil

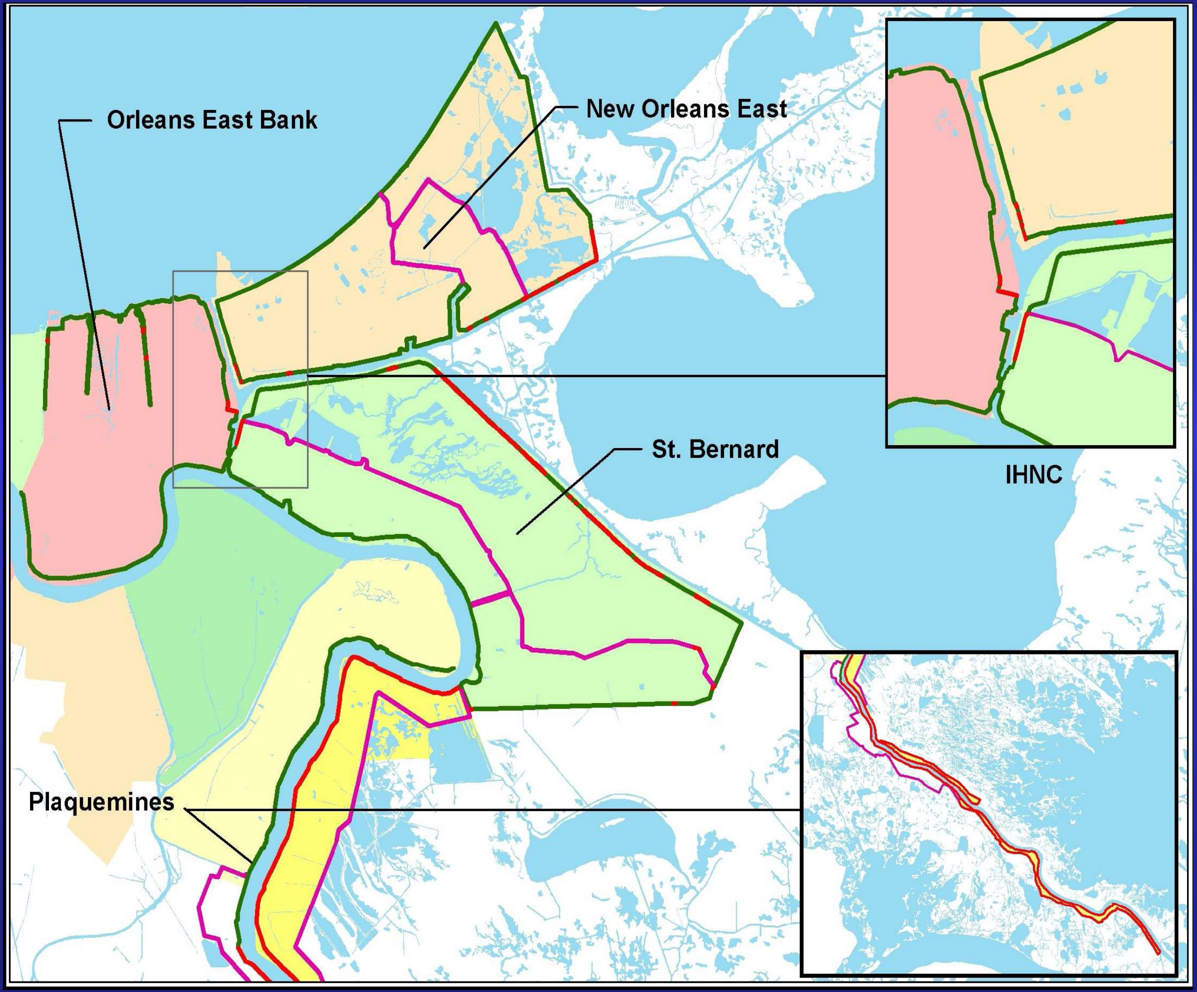
Task Force Guardian

- Restore Hurricane Protection System to pre-Hurricane Katrina levels of protection prior to 1 June 2006

US Army Corps
of Engineers®

US Army Corps
of Engineers

Hurricane Protection System Restoration Program Summary


Orleans East Bank
New Orleans East
St. Bernard
IHNC
Plaquemines

Hurricane Protection System
- 350 miles
- 71 pump stations

Damage
- 41 miles severe, 128 miles moderate damage
- 34 pump stations were non-operational

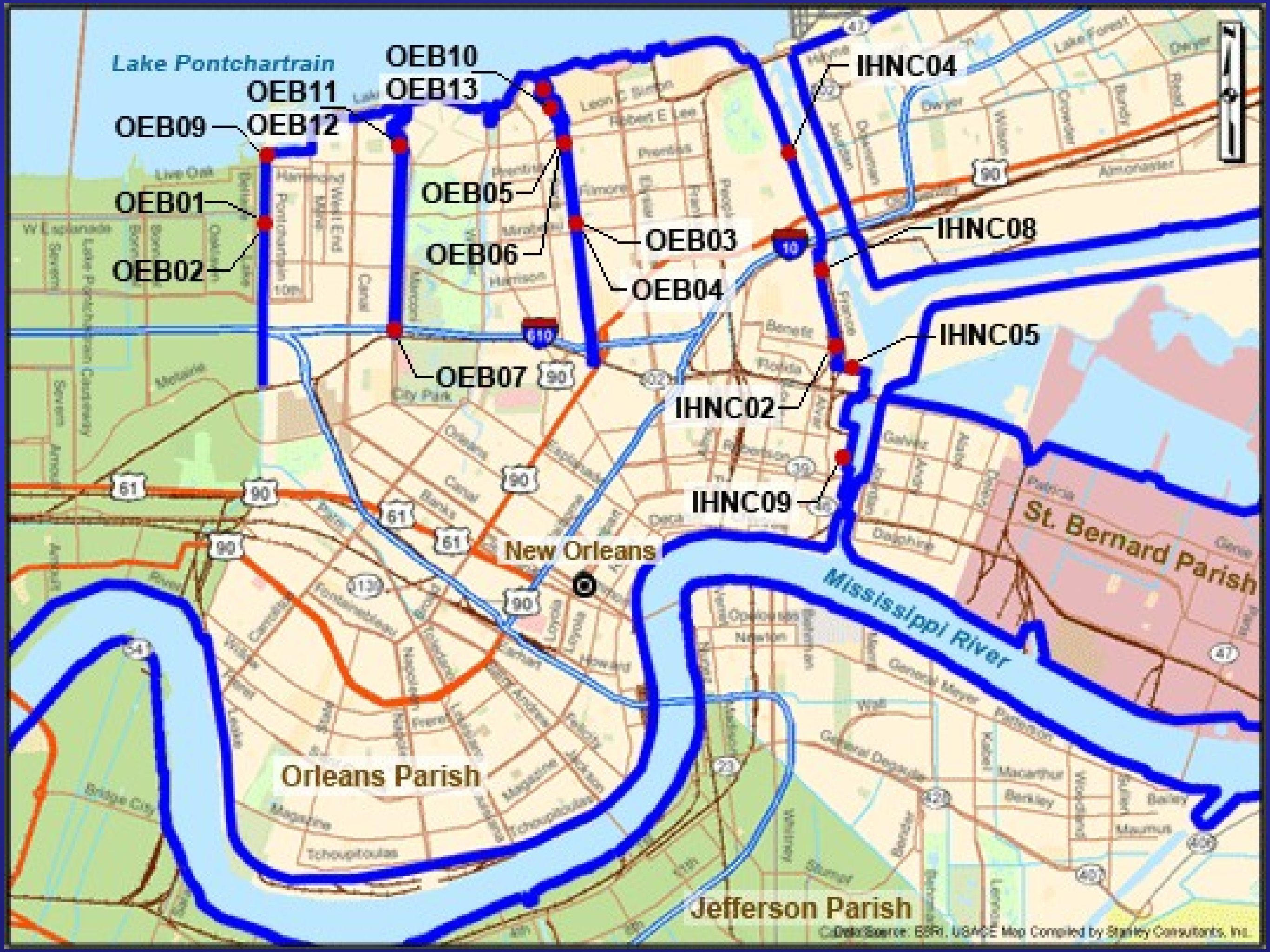
Cost
- $770 million

Hurricane Damage Rep

59% Complete

US Army Corps
of Engineers ®

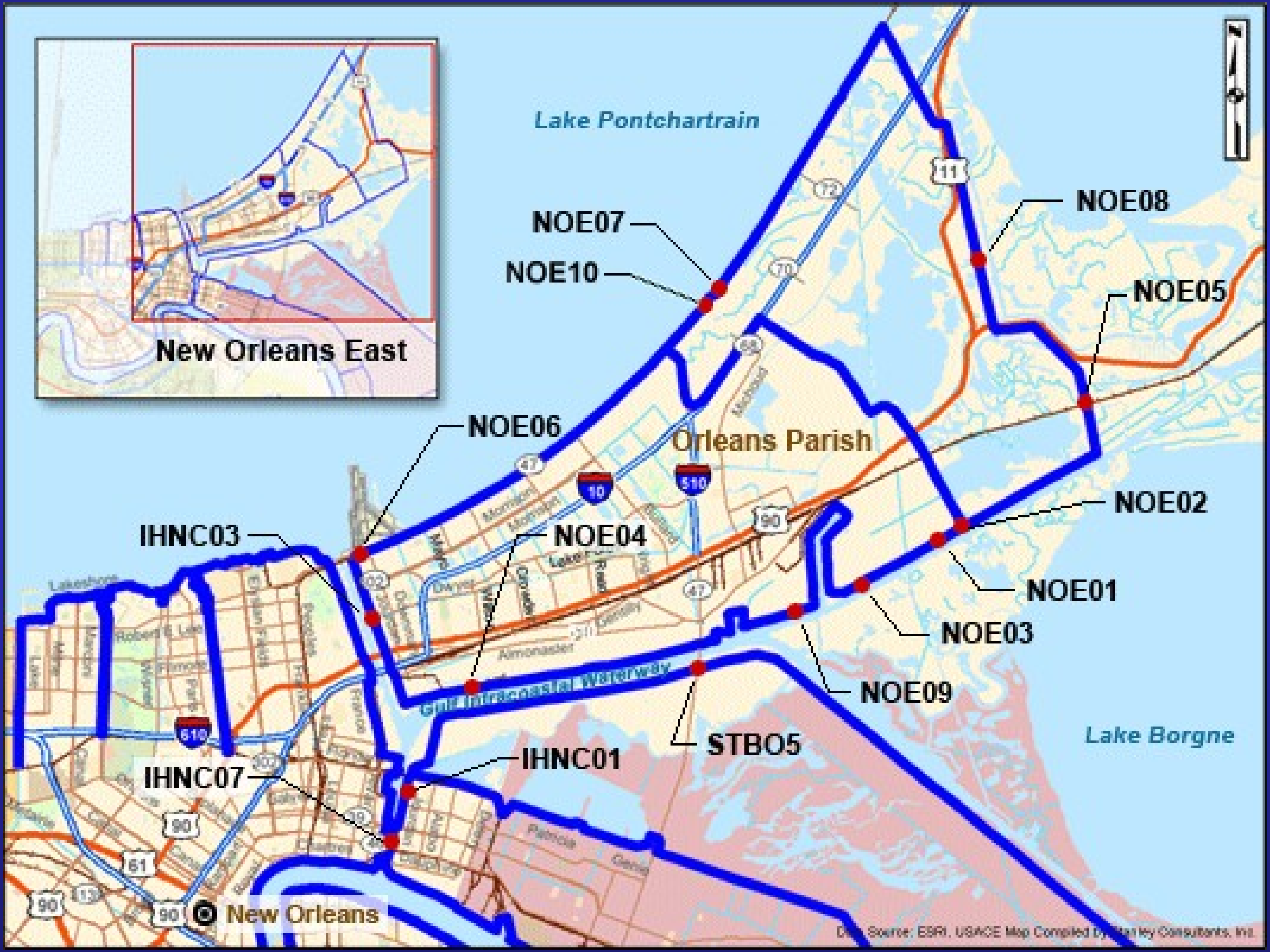
Orleans East Bank


Lake Pontchartrain
OEB10
OEB11
OEB13
OEB09
OEB12
OEB05
OEB01
OEB03
OEB06
OEB02
OEB04
OEB07
IHNC04
IHNC08
IHNC05
IHNC02
IHNC09
New Orleans
St. Bernard Parish
Mississippi River
Orleans Parish
Jefferson Parish

Data Source: ESRI, USACE Map Compiled by Stanley Consultants, Inc.

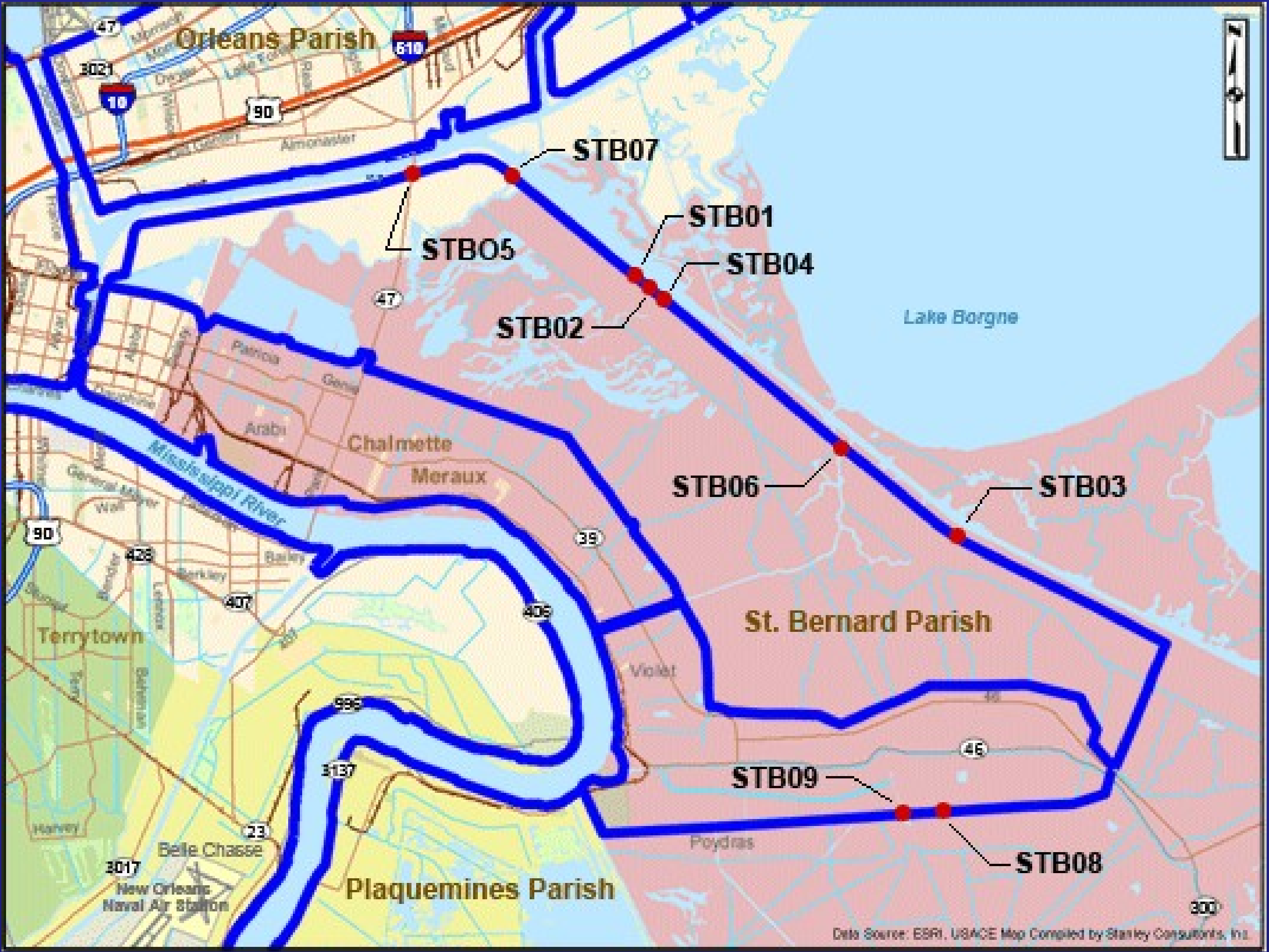
US Army Corps
of Engineers ®

New Orleans East


New Orleans East
Lake Pontchartrain
NOE07
NOE10
NOE08
NOE05
NOE06
Orleans Parish
NOE02
IHNC03
NOE04
NOE01
NOE03
NOE09
Gulf Intracoastal Waterway
STBO5
Lake Borgne
IHNC01
IHNC07
New Orleans

Data Source: ESRI, USACE Map Compiled by Stanley Consultants, Inc.

Saint Bernard Parish

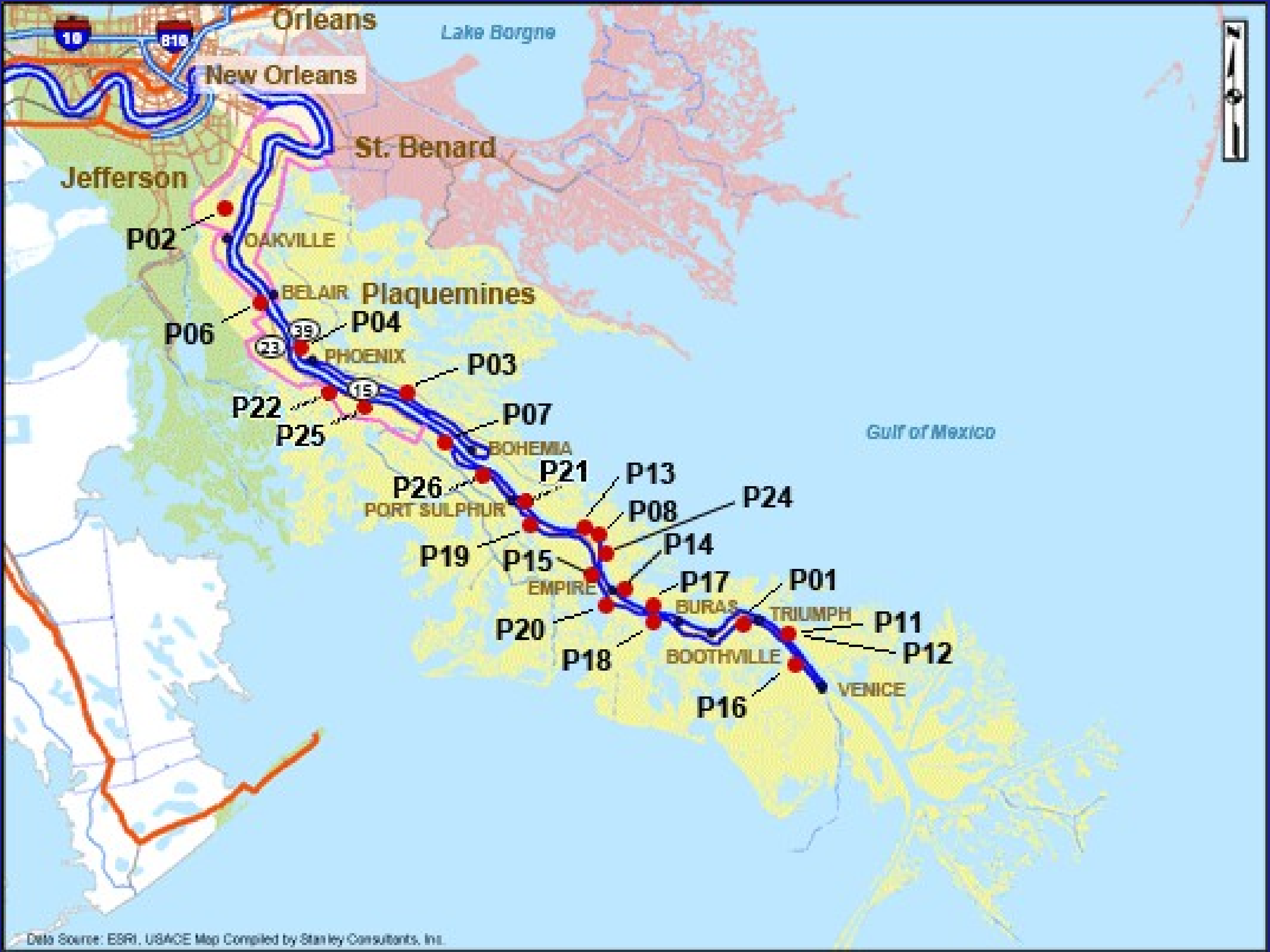

Orleans Parish
STB07
STB01
STBO5
STB04
STB02
Lake Borgne
Arabi
Chalmette
Meraux
Mississippi River
STB06
STB03
Terrytown
St. Bernard Parish
Violet
STB09
Belle Chasse
Poydras
STB08
New Orleans
Naval Air Station
Plaquemines Parish

Data Source: ESRI, USACE Map Compiled by Stanley Consultants, Inc.

US Army Corps
of Engineers ®

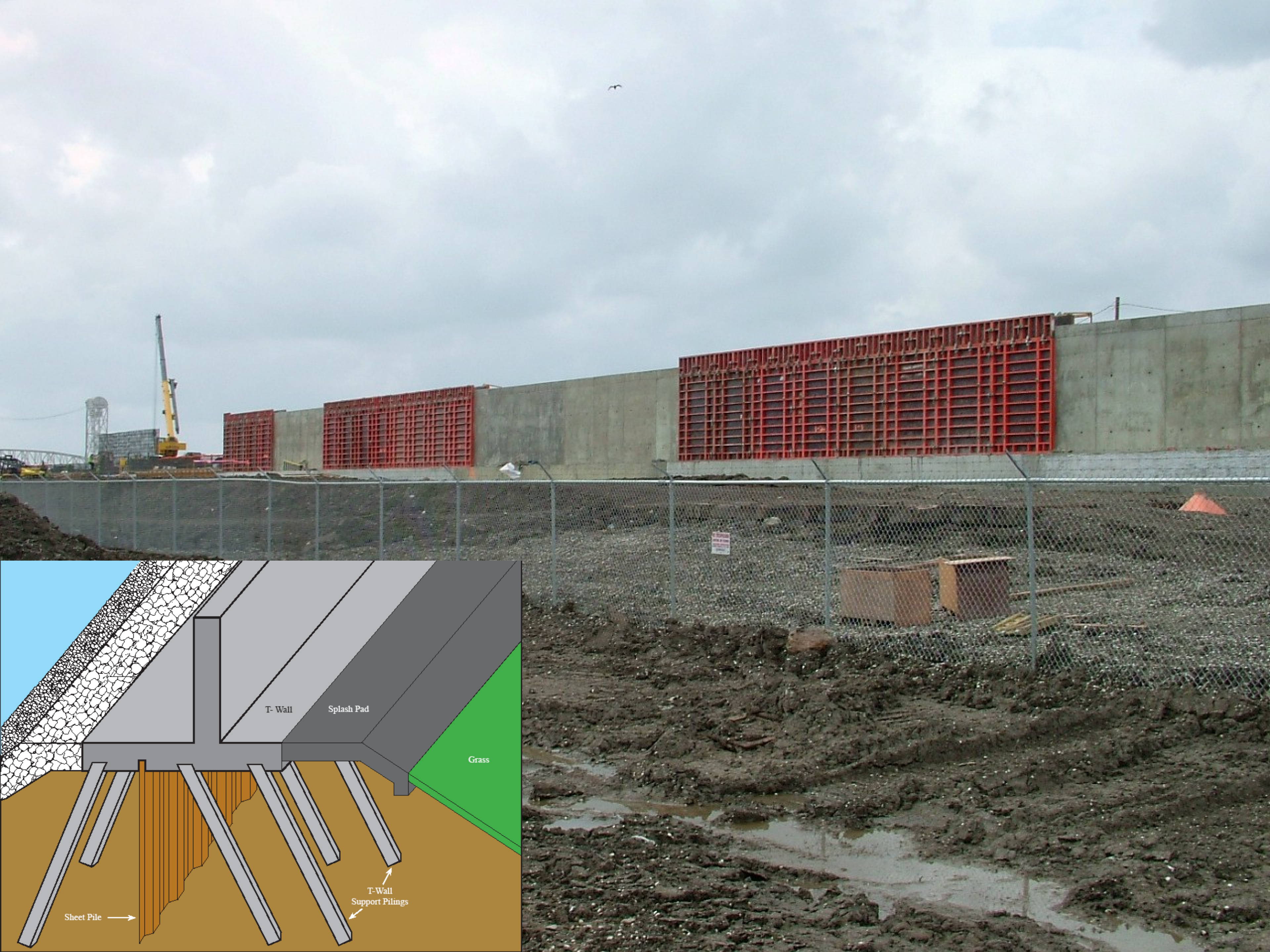
US Army Corps
of Engineers

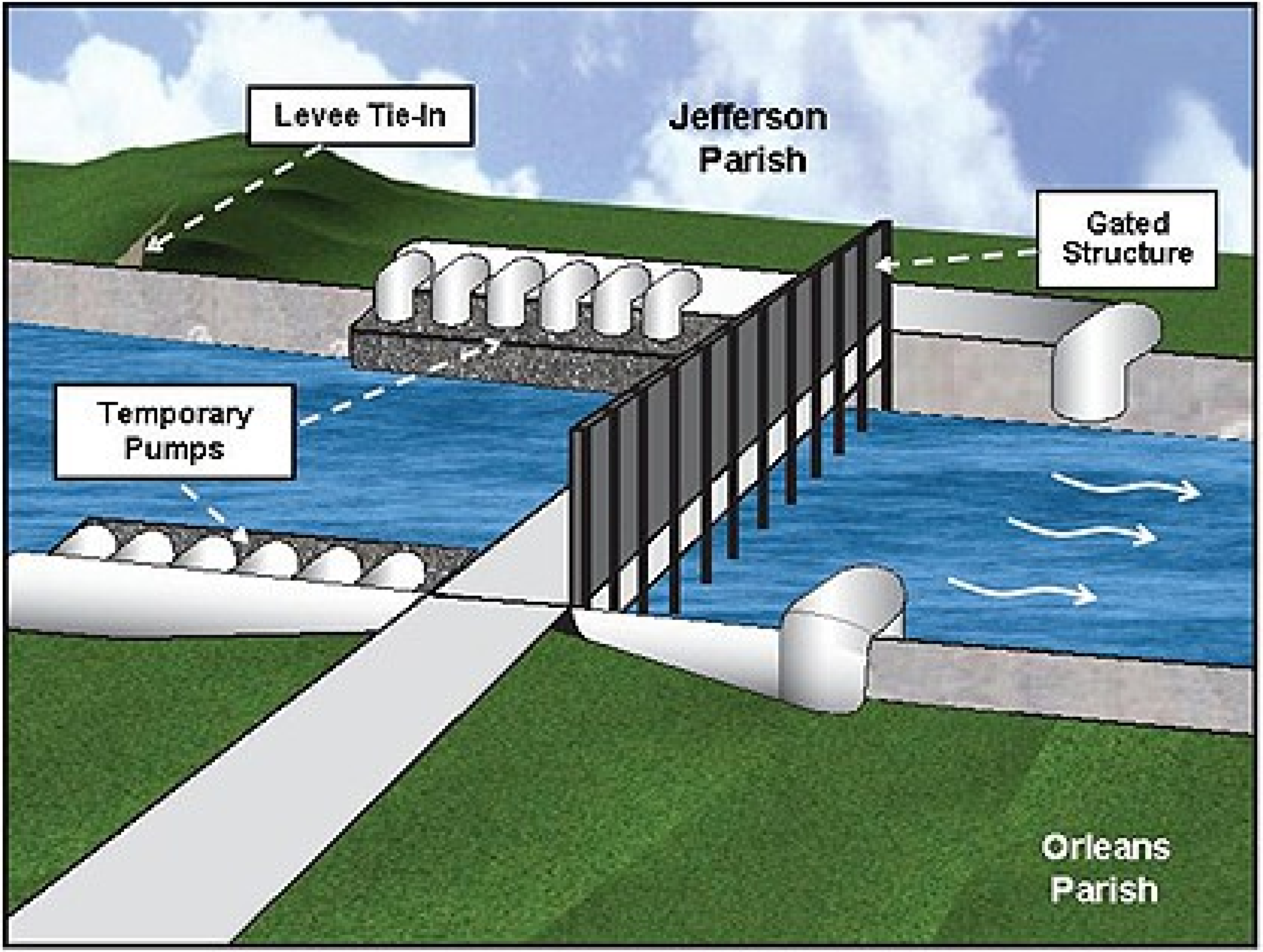
Plaquemines Pari


10
810
Orleans
Lake Borgne
New Orleans
St. Benard
Jefferson
P02
OAKVILLE
BELAIR
Plaquemines
P06
39
P04
23
PHOENIX
P03
P22
15
P25
P07
BOHEMIA
Gulf of Mexico
P26
P21
P13
PORT SULPHUR
P08
P24
P19
P15
P14
EMPIRE
P17
P01
BURAS
TRIUMPH
P11
P20
P12
P18
BOOTHVILLE
VENICE
P16

Data Source: ESRI, USACE Map Compiled by Stanley Consultants, Inc.

One Team: Relevant, Ready, Responsive, Reliable

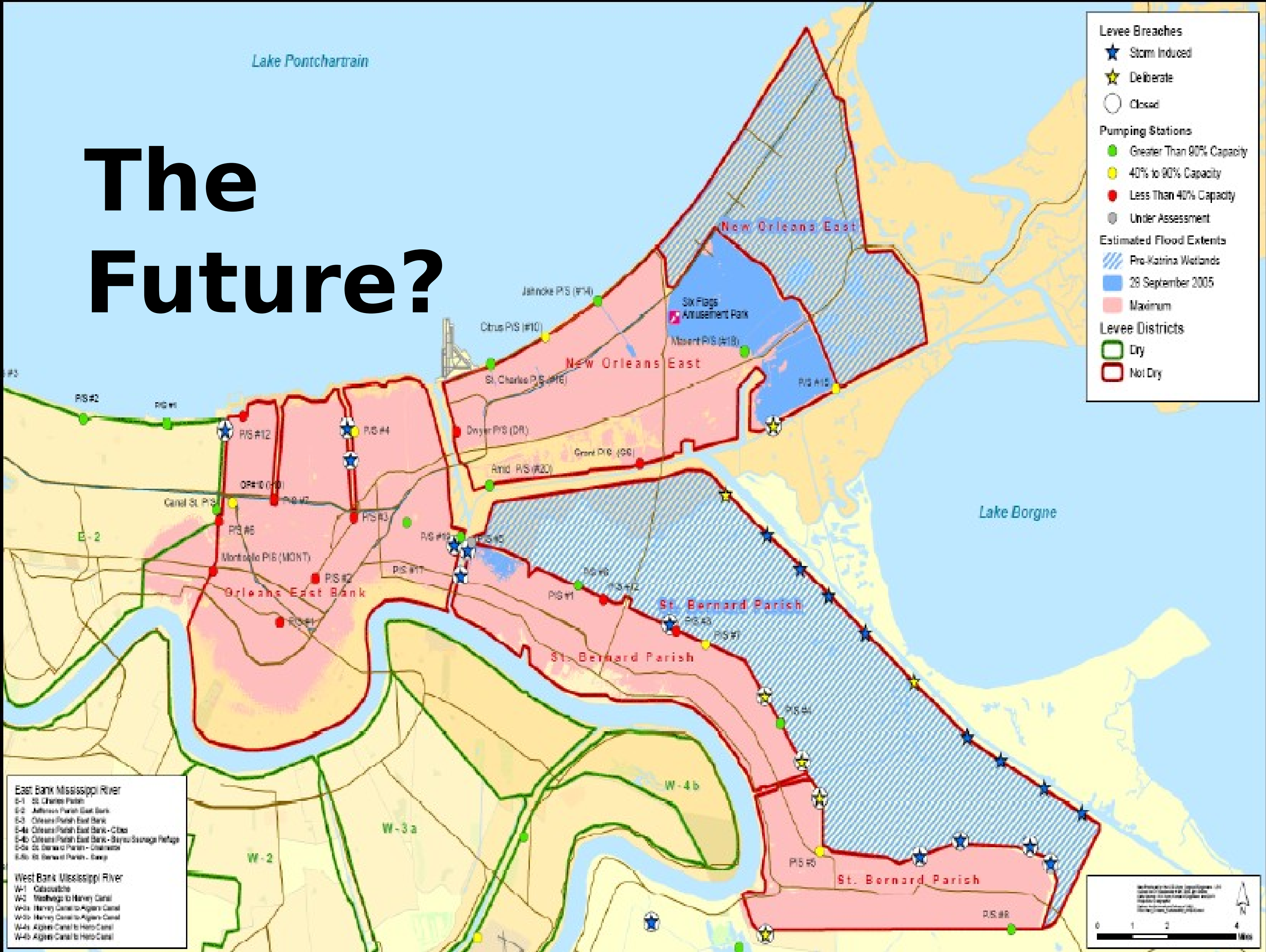

T- Wall
Splash Pad
Grass
T-Wall
Support Pilings
Sheet Pile


Levee Tie-In
Jefferson Parish
Gated Structure
Temporary Pumps
Orleans Parish

322B
SULLAIR

KOMATSU
KOMATSU
MACK

The Future?


Lake Pontchartrain
Lake Borgne
New Orleans East
New Orleans East
Orleans East Bank
St. Bernard Parish
St. Bernard Parish
St. Bernard Parish
Six Flags Amusement Park
Jahncke P/S (#14)
Citrus P/S (#10)
St. Charles P/S (#16)
Maxent P/S (#18)
P/S #15
Dwyer P/S (DR)
Grant P/S (GG)
Amid P/S (#20)
P/S #2
P/S #1
P/S #12
P/S #4
P/S #7
P/S #3
Canal St. P/S
P/S #6
Monticello P/S (MONT)
P/S #2
P/S #17
P/S #19
P/S #5
P/S #1
P/S #8
P/S #7
P/S #4
P/S #5
P/S #8
E - 2
W - 2
W - 3 a
W - 4 b
Levee Breaches
Storm Induced
Deliberate
Closed
Pumping Stations
Greater Than 90% Capacity
40% to 90% Capacity
Less Than 40% Capacity
Under Assessment
Estimated Flood Extents
Pre-Katrina Wetlands
28 September 2005
Maximum
Levee Districts
Dry
Not Dry
East Bank Mississippi River
E-1 St. Charles Parish
E-2 Jefferson Parish East Bank
E-3 Orleans Parish East Bank
E-4a Orleans Parish East Bank - Citrus
E-4b Orleans Parish East Bank - Bayou Sauvage Refuge
E-5a St. Bernard Parish - Chalmette
E-5b St. Bernard Parish - Borgy
West Bank Mississippi River
W-1 Cataouatche
W-2 Westwego to Harvey Canal
W-3a Harvey Canal to Algiers Canal
W-3b Harvey Canal to Algiers Canal
W-4a Algiers Canal to Hero Canal
W-4b Algiers Canal to Hero Canal
0
1
2
4
Miles
N